DRAFT
03-01-01

PUBLIC SAFETY ELEMENT

LAS VEGAS 2020 MASTER PLAN

CITY OF LAS VEGAS PUBLIC SAFETY ELEMENT
TABLE OF CONTENTS

MAPS

TABLES

EXECUTIVE SUMMARY

The Nevada Revised Statutes "NRS", which sets out planning law for the State of Nevada, mandates the preparation of comprehensive, long-term general plans, known as master plans. The NRS also identifies a series of required and suggested elements to be covered by the master plan for entities located within counties of more than 100,000 persons. This Public Safety Element is not a required element of the Master Plan as per NRS 278.160.

For purposes of the City of Las Vegas, the public safety element will address the following sub-elements:

- Police Services
- Fire Protection Services
- Flood Control
- Geologic Hazards
- Noise
- Transportation
- Hazardous Materials

For planning purposes, the major concern is the number of facilities and, where applicable, the optimum locations for each facility in order to best serve an established public purpose. The magnitude of public safety planning is related to both the size of the area and the number of residents to be served, and is based on sets of standards developed for each of the sub-elements. The City's Land Use Plan, which provides a guide to the location of and density at which development will occur, becomes a major determinant for public safety planning.

Downtown Las Vegas holds the distinction of being the only area whithin the city where horse patrol units are still invaluable in their service.

As an element of the City's Master Plan, the planning horizon for the Public Safety Element is 20 years. Some sub-elements may be able to be projected for a 20-year time frame and will be able to updated on an as-needed basis. This element has been prepared, as an amendment to and augmentation of the Master Plan, through input from various cities, citizen groups, and public agencies directly responsible for providing the services addressed in this plan. Each of the following sub-elements includes actions that relate to their specific issues.

- *Police Services*

  The Las Vegas Metropolitan Police Department (LVMPD) is the law enforcement agency that provides police protective services to the citizens of the City of Las Vegas, as well as residents of unincorporated Clark County. Currently, the LVMPD is headquartered in Downtown Las Vegas, and has established a number of strategically located area commands throughout its service area, based on an established policy of providing a substation for every 125,000 persons. Currently, four (4) area

commands are located within the City of Las Vegas: Downtown, Northeast, Northwest, and Southeast. However, the rapid demographic changes occurring throughout the Las Vegas Valley have warranted a number of changes to the number and location of the command posts, with the Northwest Area command relocating further north to a Cheyenne/Hualapai location; the Southeast Area Command moving out of the City to a Harmon/Pearl site; and the creation of a new West Central Command at Rainbow/U.S. 95. In addition, five (5) future sub-station locations have also been identified to accommodate future needs of the department.

In terms of staffing, the Las Vegas Metropolitan Police Department has established a service standard of two (2) police officers and one (1) civilian support staff member for every 1,000 residents. Current and projected staffing levels are anticipated to maintain this desired ratio.

- *Fire Protection Services*

The City of Las Vegas funds and maintains its own fire and rescue department to provide fire suppression and prevention services, as well as emergency medical response to the residents of the city. The Fire and Rescue Department has established a series of goals for the department including maintenance of its Class 1 ISO (Insurance Service Office) rating; response times of less than six (6) minutes; and the continued evolution of a comprehensive fire prevention and inspection program. In order to further these objectives, the department has set a level of service standards for both facilities and personnel. The number and location of fire stations is determined based on requirement established by ISO standards, which require a five (5) mile service radius in rural areas; a three (3) mile service radius in suburban areas; and one and one-half (1 1/2) mile service radius for urban areas. Currently, eleven (11) fire stations have been established within the city limits, and based on future population and density projections, ten (10) additional stations have been planned.

The Las Vegas Fire and Rescue Department maintain a level of prepardness to handle hazardous fire situations

From a personnel standpoint, the desired ratio of firefighters to resident population is 1 to 10,000. Currently, the department operates at a ratio of .80 firefighters for every 1,000 persons. In order to meet this established ratio, and also taking into consideration the continued population growth of the City, an additional 270 suppression and non-suppression personnel will be needed. A recent voter approved bond issue will provide the necessary capital to achieve this increase in personnel and provide funds for the construction of additional fire stations.

- *Flood Control*

  Due to natural and man-made factors, flooding is a critical concern of many within the entire Las Vegas Valley. Because of the regional significance and consequences of this issue, steps have been taken by the jurisdictions within the Valley to address this matter in a cohesive manner, mainly through the creation of the Clark County Regional Flood Control District (CCRFCD) in 1985. This agency has identified the critical areas of the Valley that are prone to flooding, or are major causes of flooding, and developed a master plan for the construction of facilities (detention basins, channels) that will prevent property damage and/or injury or loss of life as a result of this storm water runoff and associated flooding. The construction of these facilities will also aid in the prevention of water contamination at the primary source of drinking water for Las Vegas: Lake Mead.

Construction in progress on the I-15 Regional Flood Control project to divert flood waters from the Charleston Underpass

- *Geologic Hazards*

  There are three (3) geologic factors that greatly influence development patterns and practices within the City of Las Vegas: seismic, soil composition, and subsidence.

  - Seismically, a number of faults are present throughout the City of Las Vegas, thus construction practices have to take this factor into consideration, although no major earthquakes have ever been reported in Clark County.

  - The soils present within the City of Las Vegas are directly attributed to the topography and physiographic conditions that prevail in this portion of the state, and have a great impact on the developability of a particular site. Some of the soils found locally have a high alkaline content, which compromises the integrity of untreated steel and concrete, while others could jeopardize a building's foundation due to the shrink/swell potential of soil (the reaction of the soil when water is introduced). The City should continue to monitor these areas of concern, and require measures to address adverse soil conditions on a case-by-case basis.

  - Arguably, the most severe geologic hazard present within the City of Las Vegas would be the problem of subsidence, or the lowering of the earth's crust. Due to the continued withdrawl of water from the ground, and other natural and man-made phenomenon, certain sections of the city have experienced ground subsidence, which often results in severe damage to a structure's integrity, as evidenced by a number of documented cases. Efforts to address the problem, through groundwater recharge and/or tighter building controls and requirements, should continue.

- *Noise*

As the City of Las Vegas continues to become an increasingly urbanized municipality (as a result of the rapid growth rate and sprawling growth patterns), the urban noise levels that result from increased activity are logically going to increase as well. These increased levels are expected to have a number of impacts on the health and welfare of the residents, including non-auditory, speech interference, and sleep interference. The City of Las Vegas should take a proactive approach to mitigate noise impacts on the general population. This can be accomplished through proper zoning and site design measures, the use of open space buffers, and the construction of noise barriers where appropriate.

City of Las Vegas Fire Department must be ready to respond to a variety of unexpected diasaters, such as this plane crash into a private residence.

- *Transportation*

A safe, efficient ground transportation system is essential to public safety. In consideration of the fact that in Las Vegas the transportation system is highly dependent on street and highways for the movement of people and goods, the design of these roadways ultimately affects the safe traveling ability of the general population and enables the efficient provision of police, fire and paramedic services and other health and public safety concerns. Transportation safety should continue to be the overriding concern for all projects that impact the transportation of people and goods.

- *Hazardous Materials*

In Las Vegas, the issue of hazardous materials is primarily focused on the disposal of nuclear waste, and a proposal by the Federal Government to utilize Yucca Mountain (within the Nevada Test Site) as a nuclear waste disposal facility. There are several questions raised about this proposal including health risks to general population along transportation routes, highway transportation risks, accident potential, performance of nuclear waste holding containers, and the amount of waste anticipated for transportation and storage. In response to growing concerns about the shipment of such hazardous materials through the City of Las Vegas, the City Council recently declared itself a nuclear-free zone. The City should continue to closely monitor this issue and devise a plan to safeguard the residents of the community in the event the transportation of nuclear waste crosses into the city's boundaries.

INTRODUCTION

The Public Safety Plan, or Public Safety Element, is intended to provide policy direction to the City with regard to issues that affect the safety, health and welfare of the general public. The range of public safety issues addressed through this Element is covered under the following general headings:

- Police Services
- Fire Protection Services
- Flood Control
- Geologic Hazards
- Noise
- Transportation
- Hazardous Materials

Under each of these headings, this Element will:

- Inventory the number and location of public facilities intended to address a particular safety component;
- Identify established policies and standards, where they exist, to address safety issues;
- Identify gaps or shortcomings that may exist in the current structure of policies and standards; and
- Propose policies and actions intended to address areas of concern.

For purposes of this element, unfamiliar terms are defined in the Definitions section and unfamiliar concepts will be discussed in detail as they are introduced.

Public safety is reflected in the concern given a young accident victim

RELATIONSHIP TO THE MASTER PLAN

The Public Safety Element is one of a number of master plan components that are identified by state statute. Chapter 278.150[3] of the Nevada Revised Statutes (NRS) stipulates the elements which are mandatory in counties with a population of more than 100,000 persons, those being a conservation plan, a housing plan and a population plan.

Chapter 278.160 of the Nevada Revised Statutes goes on to identify other elective plan topics that may be appropriate subjects to be covered through a local master plan. This elective list includes two topics that are specifically covered by this Public Safety Element, those being a safety plan and a seismic safety plan. Additionally, this Element addresses the safety aspects of transportation systems within the city.

Pursuant to state legislation, this Element forms a component part of the Las Vegas 2020 Master Plan. It is intended to address where possible, the goals, objectives and policies of the Las Vegas 2020 Master Plan capstone document that was approved by City Council in September 2000. In particular, this Element addresses Objective 7.3 of the Master Plan capstone document, which states:

"To ensure that public safety problems are fully and adequately identified and that long term solutions are identified and implemented by the respective local government departments and agencies vested with those responsibilities."

As a follow up to this objective, the capstone document contains a number of policies which are addressed by this Element. These policies focus on protective services, noise issues, seismic activity and transportation safety. These policies are as follows:

Oakey Retention Basin bounded by Oakey Blvd, Torrey Pines Dr., Rainbow Blvd., and Buffalo Dr. in the northwest area of Las Vegas is one of many retention basins either completed, or scheduled for construction

POLICY 7.3.1: That the Las Vegas Metropolitan Police Department uphold its mandate in cooperation with the government of Clark County and the City.

POLICY 7.3.2: That the City continue to provide efficient and cost effective services and facilities for fire prevention, fire suppression, hazardous material control and emergency medical care for the City of Las Vegas and assist Clark County as deemed appropriate in the provision of these services for County islands and County areas north of Cheyenne Avenue and west of Decatur Boulevard.

POLICY 7.3.3: That the City participate with local governments within the Las Vegas Valley, and with other levels of government, to research, monitor and assess the effect on public safety and property that may arise from geologic hazards such as seismic activity, from land subsidence and related groundwater usage practices, and from poor soil conditions such as collapsible and expansive soils.

POLICY 7.3.4: That the City establish and enforce maximum acceptable levels for noise within residential and public areas in conjunction with state and local agencies.

POLICY 7.3.8: That the City coordinate with the appropriate entities to ensure that any contaminants from federal facilities, such as the Nevada Test Site and Yucca Mountain, do not flow into the Valley water supply as a result of seismic activities or other forces of nature. The City will ensure that wastes of all types are disposed of in an appropriate manner.

The policies and actions contained in the following sections of this Public Safety Element have been designed to comply with and implement the broader general goals, objectives and policies of the Master Plan capstone document as listed above.

The Comprehensive Planning Division is very grateful to Richard McKee,Stan Olsen and William Platter of The LVMPD, Ed Wood (retired) and Rick Gracia from Las Vegas Fire and Rescue, and Randy Fulz of Public Works. Without their help completion of this project would not have been possible. The American Red Cross should also be recognized for their assistance with emergency management information.

POLICE SERVICES

The purpose of this section of the Public Safety Plan is to explain how the services of the Las Vegas Metropolitan Police Department will be incorporated in the accomplishment of public safety in a comprehensive manner. Discussion will detail how the Las Vegas Metropolitan Police Department will interact with the City of Las Vegas per Policy 7.3.1 of the 2020 Master Plan.

BACKGROUND

The Las Vegas Metropolitan Police Department (LVMPD) handles police services for the City of Las Vegas (City) and unincorporated Clark County. An elected Sheriff commands the LVMPD. The LVMPD is responsible for the prevention and suppression of crime, the investigation and apprehension of offenders and the protection of residents and visitors. The LVMPD is also responsible for the Civil Process Section which prepares, serves and enforces all civil orders received from Nevada's district courts and State agencies.

STATION PLANNING

Planning for new stations or locations is based on a few basic criteria. Foremost, one station is intended to serve an area of 125,000 people. The stations are positioned in such a way as to be centrally located or approximately as close to the center of the projected growth as the available land will allow. The projected growth is based on projected land use, estimates by the State Demographer, and applications for sewer service.

The Downtown Area Command has been housed for several years at the historic Fifth Street School building, but will soon relocate to a new facility on East Fremont Street

EXISTING AND FUTURE INVENTORY

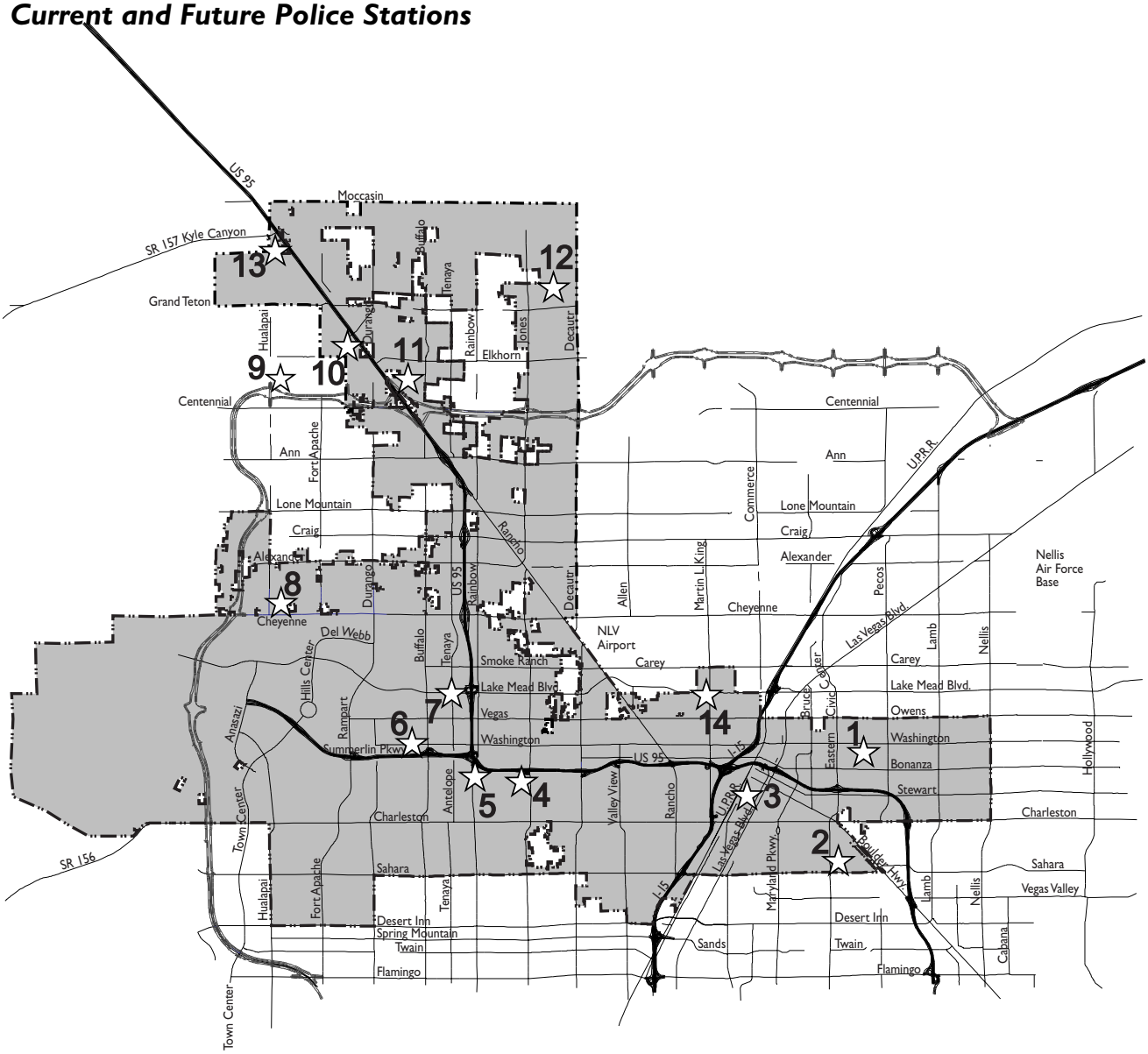
Currently, LVMPD has four area commands within the City. To increase the efficiency of the existing police services, by keeping stations centered in the areas they serve, LVMPD plans to relocate some of the existing police substations and area commands to more strategic service locations. As the LVMPD's responsibility is all of Clark County the shifting or locating of substations outside of City of Las Vegas limits may be necessary due to shifting population trends and the high growth experienced in the northwest and southeast sections of the Las Vegas Valley. Two specific changes that are forthcoming includes the relocation of the Jones/US-95 substation being moved west to Jensen Street at Cheyenne Avenue to serve that fast growing area (see Map 1) north of Cheyenne Avenue and west of U.S. 95. This new location will not only serve as the new Northwest Command center but also as a new training facility. The Downtown Area Command center has relocated to 401 S. 4th Street. LVMPD will also move the Southeast Area command at St. Louis Avenue and Atlantic Street to a new station located at Pearl Street and Harmon Avenue, outside the City limits. To keep up with the growing southern portion of the Las Vegas valley, a new substation for the Southwest area of the valley is proposed at Rainbow Boulevard and Warm Springs Road. The shifting and construction of new substations will result in two new command areas, one at Las Vegas Boulevard and Russell Road (the South Central command) and the other at Rainbow Boulevard and U.S. 95 (West Central Command).

Motorcycle patrol with radar gun "clocking" drivers

Looking even further into the future, the LVMPD is preparing for when areas such as northwest Las Vegas will be built out with a population exceeding 300,000 people. In anticipation of this growth, the LVMPD is planning on locating in the Northwest at least one new substation near one of the planned interchanges of U.S. 95 or the Beltway (I-215). The two possible locations are shown as sites 10 and 11 on Map 1. With the planned growth northward along Decatur Boulevard, the LVMPD is considering a substation near Grand Teton Drive and Bradley Road (site number 12 on Map 1). Because of growth expected near the I-215 freeway and the intersection of US 95 / Kyle Canyon Road, stations are possible in both areas. Selected sites in those areas are shown as sites 9 and 13 on Map 1. As only three substations are required to handle the planned northwest population but the actual growth areas are uncertain, any of the three of the five locations are appropriate. Selection of five locations today ensures that sites will be available in the future when they are needed. Table 1 details the inventory and planning of substations within the limits of the City.

Bicycle Patrol in the Downtown Area Command provide a quick response and a recognizable presence in the core downtown districts

Map 1
Current and Future Police Stations



Station Location Key
Existing and Future Police Stations: Number and Location

1. Mojave / Washington (Northeast Command)
2. Atlantic / St. Louis (Southeast Command)
3. 4th / Clark (Downtown Command)
4. Jones / US 95 (Northwest Command)
5. Rainbow / Westcliff (Future)
6. Buffalo / Washington (Future)
7. Tenaya / Lake Mead (Future)
8. Jensen / Cheyenne (Northwest Training Facility)
9. Grand Canyon / Centennial (Northwest Future)
10. El Capitan / Elkhorn (Future)
11. Deer Springs / Buffalo (Future)
12. Grand Teton / Bradley (Future)
13. Hualapai / Iron Mountain (Future)
14. Lake Mead / Martin L. King (Future)

Table 1
Metro Substation Planning

Map ID	Substation Description	Approximate Location	Assessor's Parcel Number	Status
1	Northeast Command	Mojave / Washington	13925303001	Current
2	Southeast Command	St. Louis / Atlantic	16201402007	Current
3	Downtown Command	4th / Clark	13934303001	Current
4	Northwest Command	Jones / US 95	13835501010	Current
5	West / Central Command	Rainbow / Westcliff	13827301001	Future
6		Buffalo / Washington	13828301002	Future
7	Northwest Central Command	Tenaya / Lake Mead	13822701002	Future
8	Northwest Command / Training	Jensen / Cheyenne	13807401009	Future
9		Grand Canyon / Centennial	12519301006	Future
10		El Capitan / Elkhorn	12517401006	Future
11		Deer Springs / Buffalo	12521601002	Future
12		Grand Teton / Bradley	12513501004	Future
13		Hualapai / Iron Mountain	12507101001	Future
14	Enterprise Park Command	Lake Mead / Martin L. King	13921416005	Future

PERSONNEL STANDARDS

In 1998, the LVMPD budgeted for 2,435 personnel, a 40% increase over the 1,455 personnel planned for in 1990. Of the 2,435 personnel, 1,633 were to be sworn Officers. During the same time span, the population for Clark County also increased by approximately 40% (749,459 to 1,255,200).

Currently, LVMPD does not base personnel needs on national averages, but on service standards. The LVMPD has set a goal of obtaining an operations standard of 2.0 police officers and 1.0 civilian support staff per 1000 residents (excluding tourists) within two years.

PLAN ACTION ITEMS

Action items of the LVMPD Strategic Plan are:

- Establish an optimum level of staffing and resources dedicated to each component of the criminal justice system.
- Analyze state and local statutes and propose necessary changes.
- Enhance the current emergency delivery systems.
- Enhance all communication capabilities by incorporating technical advances.

ISSUES

1. *Departmental Coordination*
   Activities among the criminal justice components (courts, jails, patrol, and administration) are interrelated, and therefore should remain in close proximity to affect close coordination. Automation and coordination can reduce the amount of staff expansion needed without decreasing the effectiveness of the various criminal justice components. Automation may include networking computer systems among the three entities. A computer ticket and arrest process, which allows information to be loaded by police at the scene and then read by all entities via a computer network, might save all three departments time and staff.

LVMDP Search and Resue must be able to employ a variety of life-saving techniques.

2. *LVMPD Circulation and Access*
   Street names that are duplicated or streets that have different names in various parts of the Valley can cause delays for police responses. Likewise, the LVMPD must have access to and through all developments within the City to effectively respond to all emergency calls. Gated communities must be designed to allow police and fire response teams to access and circulate throughout the entire development.

3. *Criminal Concealment*
   Design principles can be implemented to reduce the ability of criminals to conceal crimes. Building placement, lighting, and landscaping can be regulated to maximize police patrol effectiveness. This can and is being accomplished through involvement of the LVMPD in the development review process and the adoption of design standards. Currently, as site plans are submitted for review, the LVMPD reviews the plans with the goal of minimizing opportunities for crime and maximizing the safety of the public.

Las Vegas Metropolitan Police Department apprehending suspected criminals in the downtown area

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: LVMPD will provide efficient and cost-effective community facilities and services.

Objective 2A: The City of Las Vegas and its departments should continue to support police protection services and facilities provided by the Las Vegas Metropolitan Police Department (LVMPD).

Policy 2A1: The City of Las Vegas should support the efforts of LVMPD to provide continuous coverage and a timely and adequate response to emergency calls.

Program 2A1.1: The City of Las Vegas should continue to coordinate with other public agencies in matters relating to street naming and addressing.

Program 2A1.2: The City of Las Vegas should support the regulation of security gates installed within the City to ensure unrestricted access by emergency service vehicles and personnel.

Policy 2A2 The City of Las Vegas should assist LVMPD in obtaining necessary public facilities and substation sites throughout its service area from a Land Use planning standpoint.

Policy 2A3: The City will Support LVMPD programs which provide information, training, or assistance to citizens as a means of inhibiting or curtailing criminal activity.

Program 2A3.1: The City of Las Vegas should support the initiation and undertaking of a comprehensive code enforcement effort by Neighborhood Response, in conjunction with LVMPD, that addresses, but not limited to, public safety issues as addressed in the Zoning Code and this and other chapters of the Master Plan.

Program 2A3.2: The City of Las Vegas should support an improved and expanded graffiti removal program which immediately identifies and removes graffiti.

Objective 2B: Through the development review process, the LVMPD will oversee the design of public and private spaces to minimize opportunities for crime and discourage criminal activity.

Policy 2B1: The City of Las Vegas should, through the development review process, encourage design of structures and associated spaces that make will crime difficult to conceal and apprehension more readily achievable.

Program 2B1.1: The City of Las Vegas should continue to involve the LVMPD's Crime Prevention Bureau in the carrying out of defensible space reviews, as part of the development review process, on applicable projects submitted to the City for development approval.

EVALUATION AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific work programs, and a
- tool for developing work programs.

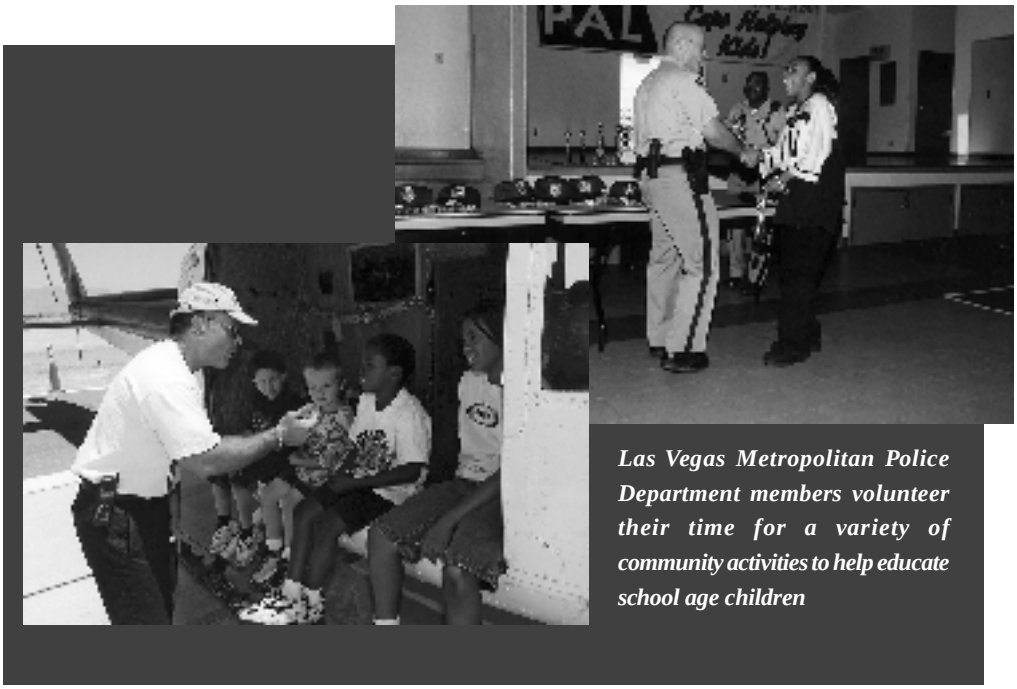
The following abbreviations apply to the Evaluation and Implementation Matrix

City Departments

BS	Building and Safety
NR	Neighborhood Response
PD	Planning and Development
FR	Fire and Rescue
LVMPD	Las Vegas Metropolitan Police Department

Other Agencies/Jurisdictions

NLV	North Las Vegas
CC	Clark County



Las Vegas Metropolitan Police Department members volunteer their time for a variety of community activities to help educate school age children

Table 2
Evaluation and Implementation Matrix : Police Services

Policy / Program	Summary	Department	Implementation	Action / Product (Realated Program)	Remarks
2A1.1	Coordinate with other public agencies in matters relating to street naming and addressing.	PD, FR	Ongoing		
2A1.2	Support the regulation of security gates to ensure unrestricted access.	FR, PW	Ongoing	Revise existing regulations such as Title 18, 19A.	
2A2	Assist LVMPD in obtaining necessary public facilities and substation sites.	PD, LVMPD	Ongoing	Updates of Land Use Plan.	
2A3.1	Neighborhood Response should, in conjunction with LVMPD, undertake a comprehensive code enforcement effort that addresses, but not limited to, public safety issues.	BS, FR, PD	Ongoing		
2A3.2	Support an improved and expanded graffiti removal program which immediately identifies and removes grafitti.	NR	Ongoing		
2B1.1	Coordinate with LVMPD defensible space reviews on applicable projects submitted to the City for development approval.	PD, LVMPD	Ongoing through site development reviews.		

FIRE PROTECTION SERVICES

The purpose of this section of the Public Safety Plan is to explain how the services of the Las Vegas Fire and Rescue Department will be incorporated in the accomplishment of public safety in a comprehensive manner. Discussion will detail how the Las Vegas Fire and Rescue Department will interact with the City of Las Vegas per Policy 7.3.2 of the 2020 Master Plan.

BACKGROUND

In 1990, what was then called the Las Vegas Fire Department implemented a master plan that was intended to propel and guide the Department into the next millennium. It was aptly called Fireplan 2000 and it proved to be a successful tool during times of explosive growth. Meant to expire in the year 2000, one of the key lessons learned was a 10-year plan was not practical due to the many variables and changes that a growing metropolis like Las Vegas can face.

The Las Vegas Fire and Rescue Department must respond to a variety of situations including multi-family house fires

After two years of intensive effort, the Department, now called Fire and Rescue, has completed the latest update to the fire master plan, which has been modified to a five-year plan for a more accurate projection potential. Although Fire and Rescue now implements plans in five year increments, the planning process and established policies are consistent with the preplanning of a 20 year Master Plan and therefore would be supportive of the City's General Plan.

The mission of Fire and Rescue, as defined in Fire Plan 2003, is "to protect life and property by providing fire prevention, suppression, investigation, emergency medical services, hazardous materials, and explosive device management services to the Las Vegas community."

The Las Vegas Fire and Rescue is comprised of four divisions: Administration, Operations, Fire Prevention, and Medical Services. In general, the divisions are responsible for planning and programming for fire prevention, enforcing fire safety standards, fighting fires, managing hazardous materials, and investigating major fires or fires of undetermined origin. The Department also maintains an emergency paramedic service.

EXISTING INVENTORY

Currently, Fire and Rescue has eleven stations that are responsible for servicing an area of approximately 110 square miles and a population of 466,312 (1999 City Estimate). Current fire station locations and three-minute response time service areas are plotted on Map 2 and are listed in the Appendix.

City of Las Vegas Fire and Rescue Department Engine 10 Fire and Rescue unit

Map 3 identifies existing and proposed City, County and North Las Vegas Fire Stations and their service areas based on Fire Plan 2003 standards.

ANALYSIS

Fire and Rescue sets optimum levels of service to effectively and efficiently perform its functions. These levels of service are based on population, population densities, tourism market, land uses, site design standards and roadway construction. The Operations Division has set the following service goals and levels of service standards:

STANDARDS OF SERVICE:

1. In accordance with the International Association of Fire Chiefs Accreditation Standards and Fire Plan 2003 (presented to City Council on November 17, 1997), respond to calls in six minutes (from receipt of call to arrival on the scene).

2. Maintain Class 1 Insurance Service Office (I.S.O.) rating.

3. The provision of Advanced Life Support (ALS) personnel and equipment on all emergency medical incidents where this level of service is required, and transportation to a local hospital emergency facility, if indicated.

4. Sufficient manpower on fire apparatus to provide for the safety of Fire fighters and provide the ability to perform basic fire fighting and rescue operations within one minute after arrival of the apparatus at the fire.

5. Comprehensive in-service pre-plan fire inspections and systems training program in all first-in and second-in response districts.

6. Comprehensive school drill programs in all public schools within the City.

Map 2
Current Fire Station Locations, City of Las Vegas

Station Location Key
Existing Stations: Number and Location

1. 500 N. Casino Center Blvd.
2. 900 S. Durango Blvd.
3. 2645 W. Washington Ave.
4. 421 S. 15th St.
5. 1020 Hinson St.
6. 190 Upland Blvd.
7. 10101 Banbury Cross Dr.
8. 633 N. Mohave Rd.
9. 4747 N. Rainbow Blvd.
41. 6989 N. Buffalo
42. 7331 W. Cheyenne Ave.

A critical goal of Fire Plan 2003 is to achieve a ratio of 1.0 firefighter per 1,000 population by calendar year 2003. Currently, it is .79 per 1,000 population. Based on the projected population increase of at least 50,000 people annually over the next five years, 270 suppression, suppression support, and non suppression personnel must be hired beginning in fiscal year 1999 through fiscal year 2004.

Fire and Rescue determines its service area radius based on population densities. The following standards are used to determine service areas.

Density	***Service Radius***
Low	5-mile radius (rural residential)
Medium	3-mile radius (suburban mixed-use area)
High	1.5-mile radius (downtown)

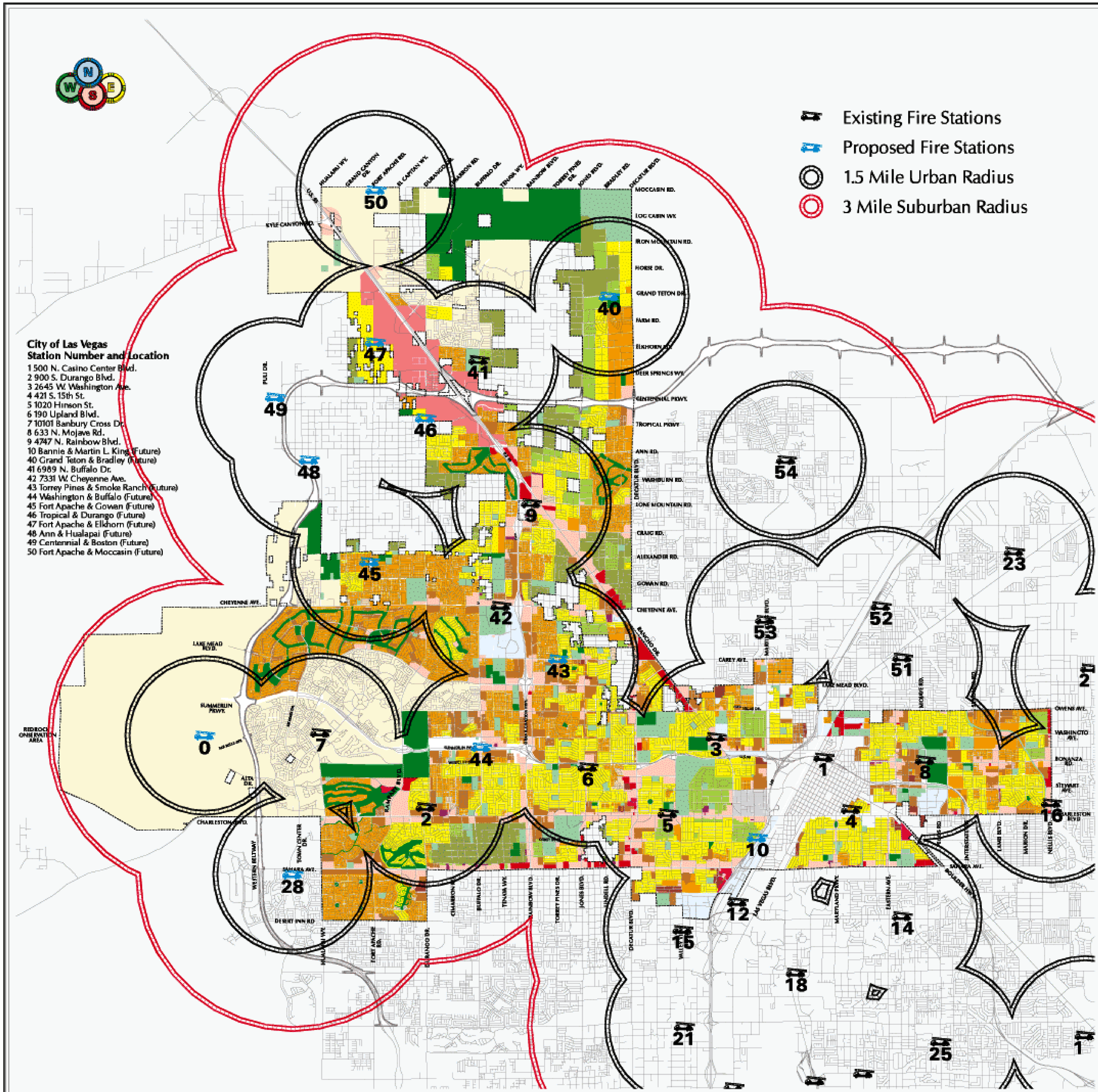
Fire stations will be located according to ISO Standards that require a first due engine company within 1.5 miles and a ladder service company within 2.5 miles for the built up areas of the city (see Map 3).

The Las Vegas Fire and Rescue Department response to a vehicular accident scene

LAND USE

The density of the population creates a major impact on the ability of Fire and Rescue to effectively service an area. Higher-density areas require more equipment and personnel to service a greater number of structures. The higher-density areas also present an increased risk of fires spreading due to the close proximity of the buildings in these areas. As seen on Map 3, the stations are generally distributed in such a way that more stations are located in those areas of greatest density. The location of the stations is not so much what areas are considered downtown or suburban, but how (residential) areas are expected to develop over time. As densities increase revisions of the location plan for future stations may need to occur. It is for this reason that the Land Use Element of the General Plan plays an essential role in the preplanning of stations.

Town Center is an example of a major planned development proposed for the city's northwest area. It will impact Fire and Rescue services with the addition of major retail facilities, power centers, single and multi-family residential, planned business, office and industrial parks, gaming, entertainment and recreational facilities.



MAP 3

City of Las Vegas

FIRE STATIONS WITH FUTURE LAND USES

- Desert Rural (0-2)
- Rural (2.1 to 3.5)
- Low (3.6 to 5.5)
- Medium-Low (5.6 to 8)
- Medium-Low Attached (8.1 to 12)
- Medium (12.1 to 25)
- High (> 25)
- Office
- Service Commercial
- General Commercial
- Tourist Commercial
- Major Medical
- Las Vegas Medical District
- Light Industrial/Research
- Planned Community Development
- Downtown Redevelopment Area
- Park/Recreation/Open Space
- Public Facility
- Town Center
- Resource Conservation
- Right-of-Way
- City Limits

0 2350 4700 7050 9400

SCALE IN FEET

GIS maps are normally produced only to meet the needs of the City. Due to continuous development activity this map is for reference only

Geographic Information System

Comprehensive Planning

702-229-6022

PLANNING & DEVELOPMENT

Development Services Center

February 27, 2001

It is the potential growth in these use areas that resulted in the placement of the future stations in Town Center (Stations 41, 46, and 47) shown on Map 3. It was the same growth in the Northwest Sector for which Stations 40, 48, 49, and 50 are positioned to address the need of growth areas such as the northwest.

Generally, as the city grows, the number of commercial / industrial developments will increase at a faster pace than in the past to keep up with the growing population. Although some city residential areas will be redeveloped for commercial uses, most of these areas will continue to age.

Most of the vacant land available in the city is located in the Northwest Sector, on parcels planned for low-density residential uses. Depending on the demand and a lack of available land for development, developers may begin to look to areas of older multi-family housing for more intense development opportunities.

These issues and impacts on service response times and service areas will be mitigated by the strategic location of new stations citywide. See maps 2 and 3.

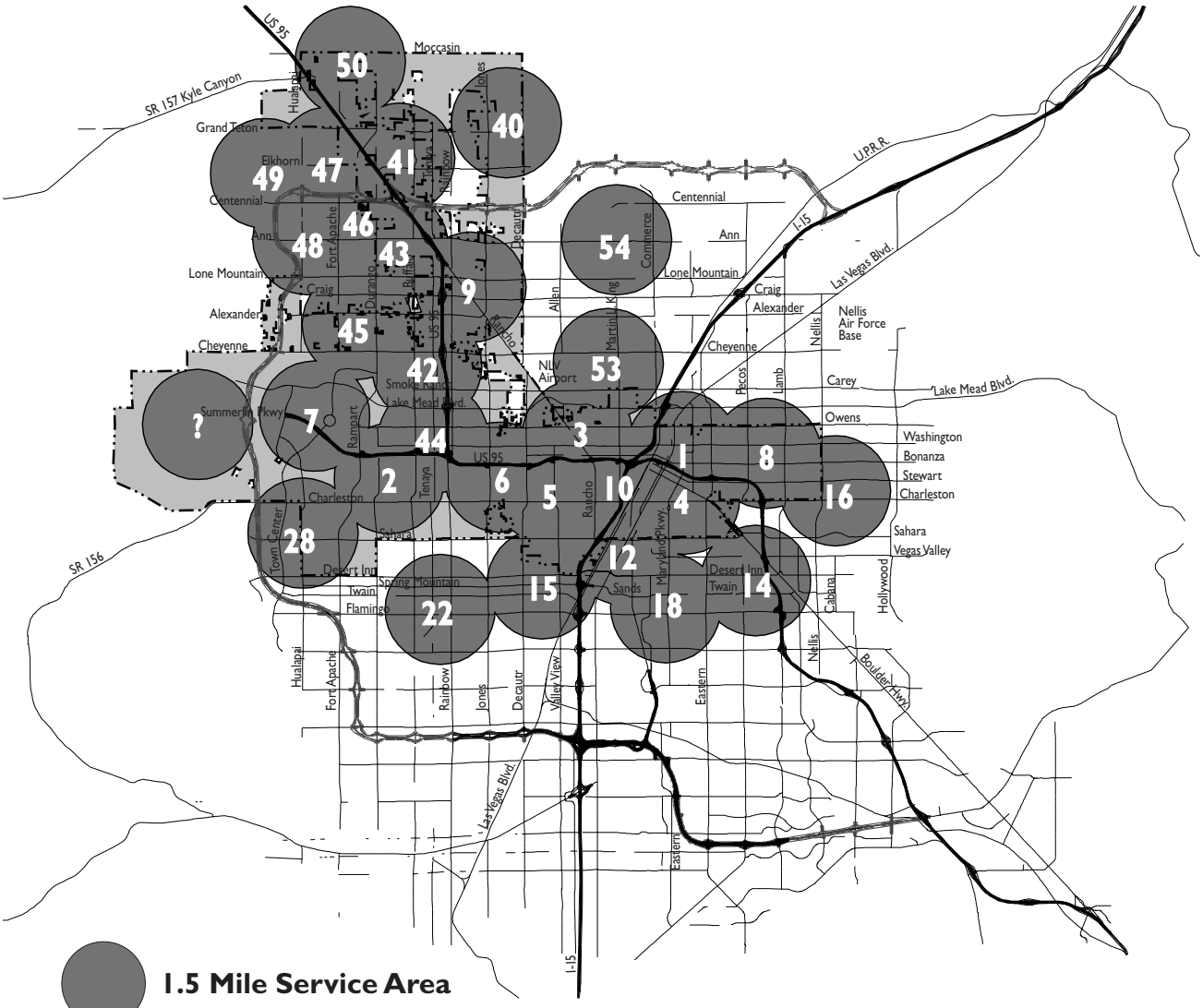
The Las Vegas Fire and Rescue Department coordinates training with Las Vegas Metropolitan Police Department

AUTOMATIC AID AGREEMENTS

The City has Automatic Aid Agreements with the Clark County Fire Department and North Las Vegas Fire Department. Under this agreement, the boundaries between entities are ignored and the closest fire station to the emergency is dispatched, regardless of which entity experiences the emergency. The total resources of the agencies are available to each entity should a large emergency occur. See Map 4 to see the relationship of the service areas for the city and surrounding jurisdictions.

The Las Vegas Fire and Rescue Department assumes responsibility for all responses to fires and emergencies occurring within County areas that are completely surrounded by City boundaries (County Islands).

Map 4
Current and Future Station Service Areas of City and Adjacent Stations



Station Location Key
City of Las Vegas
Existing Fire Stations:
Number and Location

1. 500 N. Casino Center Blvd.
2. 900 S. Durango Blvd.
3. 2645 W. Washington Ave.
4. 421 S. 15th St.
5. 1020 Hinson St.
6. 190 Upland Blvd.
7. 10101 Banbury Cross Dr.
8. 633 N. Mohave Rd.
9. 4747 N. Rainbow Blvd.
41. 6989 N. Buffalo Dr.
42. 7331 W. Cheyenne Ave.

Station Location Key
City of Las Vegas
Future Fire Stations:
Number and Location

10. Bannie and Martin L. King
40. Grand Teton and Bradley
42. 7331 W. Cheyenne Ave.
43. Torrey Pines and Smoke Ranch
44. Washington and Buffalo
45. Gowan and Fort Apache
46. Tropical and Durango
47. Fort Apache and Elkhorn
48. Ann and Hualapai
49. Centennial and Borden
50. Fort Apache and Moccasin
(Pending, Summerlin Village 21)

PLAN ACTION ITEMS

Fire Plan 2003 actions relating to Fire Protection are:

- Enhance the current emergency delivery systems.
- Enhance all communication capabilities by incorporating technical advances.
- Increase frequency and quality of fire inspection.
- Educate public, builders and policy makers on fire prevention methods.
- Provide an adequate state of readiness commensurate with the fire problems in the community.

ISSUES

1. *Facilities and Land Use*
   By developing pockets of intense development away from the downtown core of the City, the effectiveness of the existing fire fighting facilities will decrease. In effect, the development of high density uses in rural areas leaves a choice of over-serving a rural area or inadequately serving the high-density development. Certain areas of the City are adequately serviced by Clark County and North Las Vegas. These areas do not need duplicated Fire and Rescue from the City. Map 4 shows areas where Clark County and North Las Vegas service areas cover portions of the City.

2. *Access and Circulation*
   Fire and Rescue must have access to and through all developments within the City to effectively respond to all emergency calls. Therefore, gated communities must be designed to allow police and fire response teams to access and circulate throughout the entire development. This can be done through a network of interconnected streets and the use of automatic gate openers as required by fire code.

3. *Street names*
   Street names that are duplicated or streets that have different names in various parts of the Valley can cause confusion and resultant delays for emergency response teams.

The Las Vegas Fire and Rescue Department at the scene of an overturned truck on freeway

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: Provide efficient and cost-effective community facilities and services.

Objective 3A: The City of Las Vegas should support measures that protect life and property by encouraging efficient and effective facilities and services for fire prevention, fire suppression, hazardous material control, and emergency medical care per the adopted service standards.

Policy 3A1: Fire and Rescue should implement measures that protect life and property to the City of Las Vegas through effective planning and management for the City's Fire and Rescue facilities.

Policy 3A2: Fire and Rescue should implement a professional department leadership planning function, which ensures that all facets of mutual and local cooperative agreements are met and maintained.

Program 3A2.1: Fire and Rescue should implement the establishment, monitoring and evaluation of departmental goals and objectives for facilities and services on an annual basis.

Program 3A2.2: Fire and Rescue should implement the development, implementation, and update of operations and planning in conjunction with "FIREPLAN 2003".

Policy 3A3: The City should encourage the reduction of severity of fire or emergency situations through an effective code enforcement program.

Program 3A3.1: Fire and Rescue should implement inspection of all new construction job sites to ensure that the construction of fire safety items are in conformance with approved plans and that all new fire protection systems are installed and tested in compliance with all fire codes, standards, and ordinances.

Program 3A3.2: Fire and Rescue should implement the inspection of all occupied buildings on an "as-needed" basis, inspect all businesses applying for a business license, and act on all complaints or requests from the public.

Program 3A3.3: Fire and Rescue should implement the inspection/evaluation of the issuance of appropriate permits and maintenance of records for all facilities that store, use or manufacture hazardous chemicals / materials.

Policy 3A4: Information Technologies should improve all communication and mapping capabilities by encouraging the utilization of technical advances of the Geographic Information Systems (GIS) of the City and County.

Policy 3A5: The City should encourage proper site design and correct street naming to facilitate emergency access of fire vehicles.

Program 3A5.1: Planning and Development should develop design standards linked to the Subdivision Ordinance, mutually acceptable to the police, fire, and planning agencies, to facilitate emergency access and services.

Program 3A5.2: Planning and Development should continue to notify in a timely manner interdepartmental and interagency representatives of pending development applications, to resolve issues that pertain to site development review and emergency access and services.

Policy 3A6: The City should support the efforts of Fire and Rescue to provide continuous and timely adequate response to emergency calls.

Program 3A6.1: Fire and Rescue and Planning and Development should continue to coordinate with other public agencies in matters relating to street naming and addressing.

Program 3A6.2: Planning and Development and Public Works should support the regulation of security gates by revising Titles 18 and 19A to require gate access to be shown on proposed subdivision maps.

Policy 3A7: Support Fire and Rescue's efforts to obtain optimal locations for necessary public facilities and substation sites throughout its service area.

Program 3A7.1: Planning and Development should continue to assist Fire and Rescue with location and acquisition of new sites by working with Real Estate Division in the determination of of appropriate fire station locations per the service standards and availability of BLM lands.

EVALUATION AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific work programs, and
- tool for developing work programs.

The following abbreviations apply to the Evaluation and Implementation Matrix

City Departments

PD	Planning and Development
FR	Fire and Rescue
LVMPD	Las Vegas Metropolitan Police Department
IT	Information Technologies
PW	Public Works

Table 3
Evaluation and Implementation Matrix : Fire Protection Services

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
3A1	Continue to plan and manage the city's fire services.	FR	Ongoing	Fire Plan 2003	ISO rating of 1
3A2.1	Establish, monitor and evaluate departmental goals and objectives for facilities and services on an annual basis.	FR	Ongoing	Fire Plan 2003	
3A2.2	Annually develop, implement and update operations and planning.	FR	Ongoing	Fire Plan 2003	
3A3.1	Inspect new construction for fire code violations	FR	Ongoing	Schedule and inspections criteria.	
3A3.2	Inspect occupied structures as needed.	FR	Ongoing	Inspection and report.	
3A3.3	Inspect hazardous materials handlers.	FR	Ongoing		
3A3.4	Improve all communication and mapping capabilities by incorporating technical advances of the city and county's GIS.	FR, IT	Ongoing		
3A6.1	Coordinate with other public agencies in matters relating to street naming and addressing.	PD, CC, NLV, Henderson, FR	Ongoing		
3A6.2	Support the regulation of security gates in the City to ensure unrestricted access by emergency services vehicles and personnel.	PD, FR, PW	Ongoing	Revise existing regulations such as Title 18, 19A.	
3A7	Obtain optimal locations for necessary public facilities and fire station sites throughout its service area.	PD, FR	Ongoing	General Plan and updates.	

DRAINAGE AND FLOOD CONTROL

The purpose of this section of the Public Safety Plan is to explain how the services of the Las Vegas Public Works Department and the Regional Flood Control District will be incorporated in the accomplishment of public safety in a comprehensive manner. Discussion will detail how these agencies will interact with the City of Las Vegas per the general policies of the Las Vegas 2020 Master Plan.

INTRODUCTION

Several major regional flood control projects have been under construction around the valley

Flooding is one of the more severe environmental hazards affecting the Las Vegas Valley area, despite an average annual precipitation of only four inches. Winter storms cover a large area and historically have not produced major flooding. The summertime high-intensity thunderstorms produce most of the flooding in the area. Washes fill quickly and overflow onto surrounding areas.

Natural and man-made factors contribute to flooding. The natural factor is the presence of predominantly shallow soils overlaying hardpan, a hardened or cemented soil horizon, that inhibits the infiltration of rainfall into the underlying soils. Also, there is a lack of natural ground cover- shrubs, trees, and grasses - that would slow this runoff. The resulting water builds in velocity and quantity as it flows down the washes resulting in downstream flooding. The man-made factor is contributed through paved roads, roofs, parking lots, and other impervious surfaces coupled with the lack of storm water sewers. These provide hard surfaces that prohibit the percolation of water into the area where it falls and collects. The collection and concentration of runoff caused by urbanization can result in an increase in downstream flooding. Development in flood plains without adequate flood control facilities has also resulted in flood damage.

REGIONAL FLOOD CONTROL PLANNING

The Clark County Regional Flood Control District (CCRFCD) was created in 1985 in an effort to enhance regional flood planning and control in Clark County. By December, 1986, the CCRFCD published the Clark County Flood Control Master Plan. Clark County

and each of the incorporated cities within the County adopted the Master Plan. NRS Chapter 543 requires that all the local governments in the CCRFCD adopt drainage regulations. The regulations restrict new development in areas known to flood, require drainage studies on proposed new developments to address localized flooding, and require CCRFCD review of all new developments in areas of regional flood control significance.

Construction of flood control channel at Wall Street, part of the I-15 flood control project

STORMWATER MANAGEMENT

In 1988, the United States Environmental Protection Agency (EPA) proposed regulations that required cities with populations of 100,000 or more to apply for National Pollution Discharge Elimination System (NPDES) permits for controlling stormwater discharges to water ways, such as rivers, streams, lakes, etc. An EPA study indicated that 38 states reported urban run-off as a major cause of water quality impairment in the United States. Stormwater runoff can pick up such contaminants as pesticides and fertilizers from lawns; oil, grease, and fuel from gas stations; and other contaminants from construction sites, restaurants, dry cleaners, lumberyards, landfills, junk yards, and industrial sites.(1) These contaminants find their way directly into bodies of water without going through sanitary treatment first.

Rather than requiring additional treatment plants or expansions to existing plants to accommodate end-of-pipe treatment of stormwater, EPA appears to be favoring non-structural best management practices (BMPs) and stormwater management plans to control pollutants at their source.(2) BMPs include the following:

- finding and removing illicit connections to storm sewers instead of sanitary sewers;
- developing and implementing local ordinances to reduce pollutants from construction sites, new development sites, and new industrial sites;
- public education on the use of chemical fertilizers and pesticides;
- encouraging proper disposal and the recycling of used oil and hazardous wastes from households; and
- improving operations and maintenance practices of commercial enterprises.

The City of Las Vegas is a co-permittee of the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit. The permit designates the Clark County Regional Flood Control District (CCRFCD) as Lead Agency for permit implementation, with CCRFCD and the Cities of Las Vegas, North Las Vegas Henderson, Clark County and the Nevada Department of Transportation (NDOT) identified together as Co-permittees. The effective date of the current permit is June 16, 1997, and the formal expiration date is June 16, 2002. This permit was reissued based on the original NPDES municipal stormwater discharge permit of December 13, 1990. In compliance with the conditions of the permit, an annual report is prepared in August of each year. The report is organized based on the "Monitoring Requirements and Conditions" in the new permit and the "Schedule of Compliance, Monitoring Requirements, Best Management Practices and Conditions" in the original permit.

Pipeline is part of collection system that was constructed in the northwest area

SERVICE STANDARDS

The service standards for Flood Control are those that are required by Nevada Division of Environmental Protection. The standards are the requirements for the implementation of the Best Management Practices set forth in the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit. The City of Las Vegas and the other co-permittees are in full compliance with the requirements of the Las Vegas Valley NPDES Municipal Stormwater Discharge Permit.

THE SYSTEM

THE CCRFCD SYSTEM

These facilities include large diameter pipe, reinforced concrete boxes, and detention basins, which are designed to collect the 100-year flow (500 cfs minimum). See Map 5. This system includes 13 existing detention basins along with approximately 60 miles of existing storm drains and channel. Construction and maintenance funding of these facilities comes through the Clark County Regional Flood Control District (CCRFCD). Regional facilities provide the infrastructure or trunk lines for the local storm drain facilities.

THE CITY SYSTEM

The City system includes smaller diameter pipes, which are designed to collect either 10-year flows, or nuisance flows. There are approximately 194 miles of local facilities within the City. Flood Control has completed two neighborhood drainage studies, which identify proposed local facilities in the northwest area. These facilities are constructed primarily within RTC road corridors with RTC projects or with private developments.

CURRENT DEVELOPMENT NEEDS

Proposed developments are required to comply with the Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual. All development projects 2-acres or greater are required to complete a Technical Drainage Study. In the study the engineer identifies the drainage impacts of the project and provide a means to mitigate them.

ADDRESSING FUTURE NEEDS

The proposed drainage facilities will ensure the CCRFCD Design Manual criteria are met which provides for the safe conveyance of stormwater flows. This generally means in RTC road corridors the 10-year flow will be intercepted in an underground conveyance system that discharges into a regional system. The proposed regional facilities will collect the 100-year flows and safely convey them to channels or detention basins. The future system of local and regional facilities will greatly reduce the flooding that currently exists across the valley.

Desert landscaping around perimeter of Gowan Retention Basin serves a dual purpose to both improve the basin's overall appearance and control ground erosion.

Map 5 shows the planned expansion and improvement of the existing system. The planned elements on Map 5 show how the system will be in 20 years or at system build-out. The major elements of the planned system are the regional drainage facilities. The minor elements are the facilities under the control of local agencies.

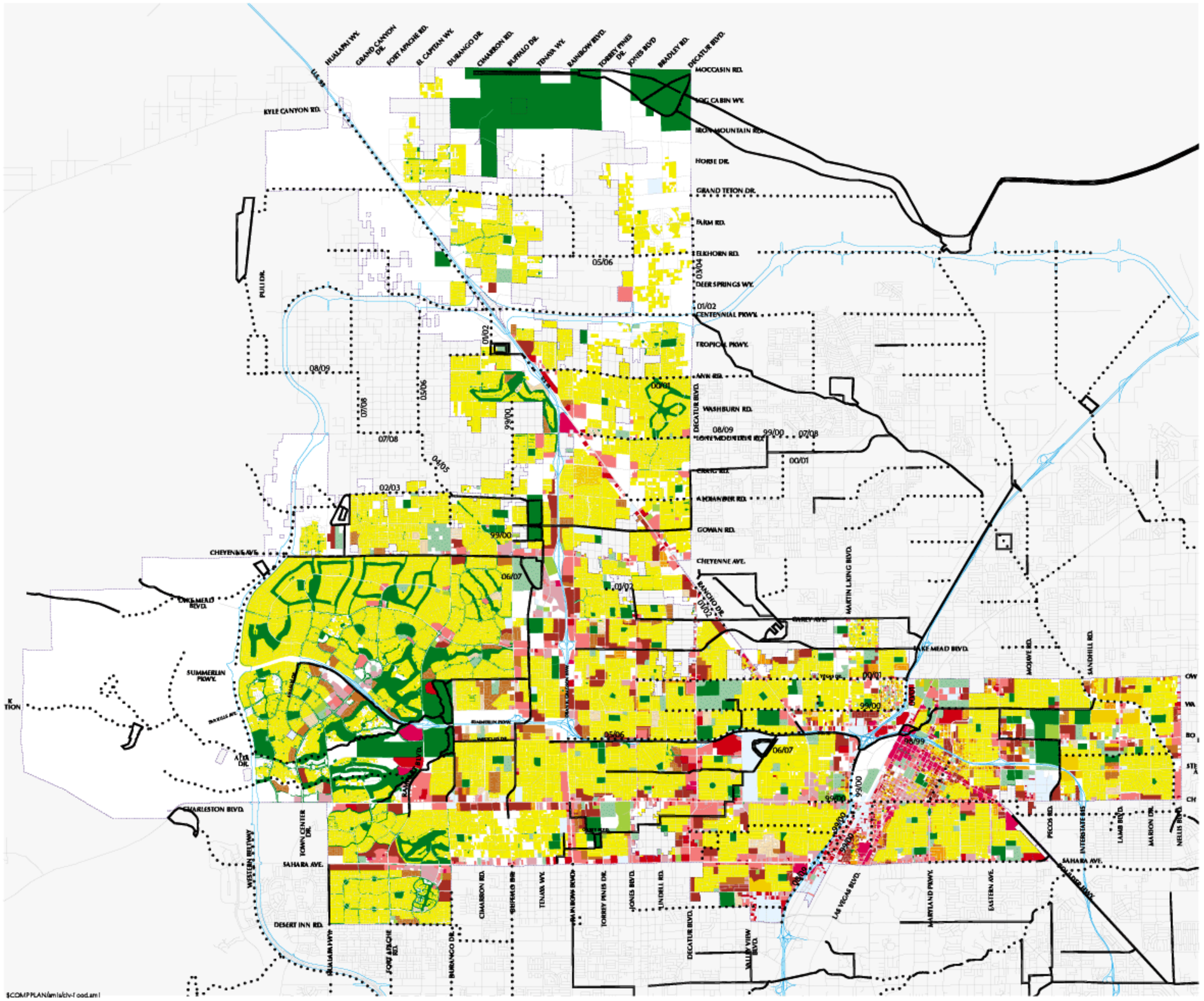
ISSUES

1. Areas Prone to Flooding

The Las Vegas Valley is susceptible to flash floods affecting the safety and quality of life of the Valley residents. Flooding occurs due to heavy localized rainfall combined with the natural topography and soil conditions found in the Valley. However, the adverse effects of flooding to Valley residents is due partly to poor planning in the past and to the lack of flood control facilities preceding urbanization.

2. Contaminated Runoff

Stormwater runoff picks up contaminants such as pesticides and fertilizers from lawns, trash and debris, oil, grease, and gasoline, etc. These contaminants discharge to the Las Vegas Wash and Lake Mead without sanitary treatment. Appropriate stormwater management and discharge regulations will be necessary to abate polluted runoff.



MAP 5

City of Las Vegas

EXISTING LAND USE
with Flood Control Facilities

- Single Family
- Mobile Homes Parks
- Duplex
- Townhouses/P.U.D.'s
- Condominiums
- Apartments
- Group Quarters Facilities
- Schools/Parks/Open Space
- Non-Profit Organizations
- Tourist Commercial
- Office
- Service Commercial
- General Commercial
- Agriculture/Ranching
- Ind/Comm/Trans/Utilities
- Minor Improvements
- Vacant Land
- Existing Flood Control (Channels & Basins)
- Proposed Flood Control (Channels & Basins)
- City Limits

27 February 2001

0 1950 3900 5850 7800

SCALE IN FEET

City maps are currently produced only to meet the needs of the City. Due to continuous development activity this map is for reference only.

Geographic Information System

Comprehensive Planning
702-229-6822

PLANNING & DEVELOPMENT
CITY OF LAS VEGAS
Development Services Center

$COMPPLAN\maps\chv-flood.aml

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: The City should participate in the protection of the environmental quality of the Las Vegas valley and to promote the conservation of our natural resources.

Objective 4A: Public Works should implement a diversified, efficient flood control system to protect life and property from severe flood damage at a reasonable cost.

Policy 4A1: Public Works should develop a two-tiered flood control system which should include an appropriate mix of large regional and smaller city neighborhood flood control facilities.

Program 4A1.1: Public Works should implement stormwater channel and drain improvements in accordance with the adopted stormwater management program for the City.

Policy 4A2: The City should continue the implementation of the adopted Master Plan of the Clark County Regional Flood Control District. This Plan provides for construction and maintenance of the large regional component of the City's flood control system, including detention basins, drainage channels and storm drains.

Policy 4A3: Public Works should develop neighborhood master plans consisting of relatively small city drains and other flood control facilities to safely convey flood and nuisance flows to the larger regional facilities. These plans should be prioritized as part of the capital facilities programming process.

Policy 4A4: Public Works should continue the review of plans for new development of property under zoning and subdivision regulations to ensure optimal property drainage in accordance with City Uniform Regulations for the Control of Drainage and the Clark County Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual.

Program 4A4.1: Public Works should continue the review of development plans to incorporate, where required, the neighborhood storm drain system plans for the City and the master plan for Clark County Regional Flood Control District.

Policy 4A5: Public Works should investigate and, where necessary, implement funding mechanisms for city neighborhood stormwater capital programs. Funding sources may include, but not be limited to, special improvement districts or stormwater utility fees.

Policy 4A6: Public Works should continue the inspection and maintenance of existing stormwater facilities to provide for the safe and efficient passage of flood water.

Policy 4A7: Public Works should continue to maintain a broadly based Flood Hazard Reduction Program which meets the requirements of the National Flood Insurance Program (NFIP). The City should continue to participate in the federal Community Rating System, thus assuring the availability of flood insurance to city residents and businesses at the least possible cost.

Policy 4A8: Public Works should continue to support the update of Flood Insurance Maps for existing city areas and to create new maps for developing areas, subject to FEMA review.

Objective 4B: The City should continue to participate in a multi-jurisdictional effort to develop, implement and monitor water quality standards for stormwater discharge.

Policy 4B.1: Public Works should continue to implement the comprehensive Stormwater Quality Management Plan in accordance with the valley-wide NPDES stormwater discharge permit.

Program 4B1.1: Public Works should continue to be a participant in valley-wide programs for stormwater quality management.

Program 4B1.2: Public Works should initiate the implementation program for Stormwater Quality Management Plan.

Program 4B1.3: Public Works should continue to inventory the existing stormwater facilities to address nonpoint pollution sources.

Program 4B1.4: Information Technologies Department should encourage the use of the City Geographic Information System (GIS) in coordination with Clark County GIS in the creation and maintenance of Stormwater Quality Management Plan data to evaluate the plan's effectiveness.

Policy 4B2: Public Works should modify City regulations as needed in order to implement stormwater quality discharge standards as they are developed by the State and the U.S. Environmental Protection Agency.

Program 4B2.1: Public Works should coordinate with all appropriate entities and agencies in the Valley to establish individual stormwater quality responsibilities and to prepare a funding strategy.

Regional Flood Control District project along I-15

EVALUATION AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific programs, and
- tool for further developing work programs.

The following abbreviations apply to each Evaluation and Implementation Matrix

City

CA	City Attorney
CM	City Manager
FN	Finance
PW	Public Works
PD	Planning and Development

Other Agencies/Jurisdictions

CC	Clark County
HEND	City of Henderson
LVVWD	Las Vegas Valley Water District
NLV	City of North Las Vegas
CCRFC	Clark County Regional Flood Control District

Northwest Water Resource Center construction project along Rampart to connect the water treatment facility for the reutilization of "gray" water

Table 4
Evaluation and Implementation Matrix : Drainage and Flood Control

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
4A1	Develop a two tiered flood control system which will include an appropriate mix to large regional and smaller city neighborhood flood control facilities.	PW, CM, CCRFC	2001	Coordinate funding via CLV and CCRFC CIP.	
4A1.1	Provide stormwater channel and drain improvements in accordance with the adopted stormwater management program for the City.	PW			
4A2	Continue to have the City cooperate in the implementation of the adopted master plan of the Clark County Regional Flood Control District (CCRFCD).	PW		Construction and maintenance of the regional component of the City's flood control system.	
4A3	Develop neighborhood master plans consisting of relatively small city drains and other flood control facilities to safely convey flood and nuisance flows to the larger regional facilities.	PW, FN, CCRFC	2001	CLV CIP based on CCRFC plans and neighborhood needs.	Prioritized per CIP.
4A4	Review plans for new development of property under zoning and subdivision regulations to ensure property drainage in accordance with City Uniform Regulations for the Control of Drainage and the Clark County Regional Flood Control District's Hydrologic Criteria and Drainage Design Manual.	PW			
4A4.1	Review development plans to incorporate, where required, the neighborhood storm drain system plans for the City and the master plan for Clark County Regional Flood Control District.	PW			
4A5	Investigate and, where necessary, implement funding mechanisms for city neighborhood stormwater capital programs.	PW, CA	2001	Inventory of funding sources, strategy for use, and use of known sources.	Funded by SID and other fees.
4A6	Inspect and maintain existing stormwater facilities to provide for the state and efficient passage of flood water.	PW	Ongoing	Facilities maint.	
4A7	Maintain a broadly based Flood Hazard Reduction Program which meets the requirements of the National Flood Insurance Program (NFIP). The City should continue to participate in the federal Community Rating System, thus assuring tha availability of flood insurance to city residents and businesses at the least possible cost.	PW	Ongoing	Program participation and documented actions to reduce insurance costs to citizens.	

Table 4
Evaluation and Implementation Matrix : Drainage and Flood Control, continued

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
4A8	Continue to update Flood Insurance Maps for existing city areas and to create new maps for developing areas, subject to FEMA review.	PW	Ongoing	Best available maps.	
4A9	Investigate land development grading requirements to determine if nuisance flows and first storm runoff should be retained on site.	PW	2002	Amend code to require on site retention facilities.	
4B1.2	Detail implementation program for Stormwater Quality Management Plan.	PW, CC	2002	Implementation plan	
4B1.3	Inventory existing stormwater facilities and locate industrial nonpoint pollution sources.	PW, CC	2003	Inventory of facilities and nonpoint sources.	
4B1.5	Establish a monitoring program to evaluate Stormwater Quality Management Plan effectiveness.	PW, CC	2004	Report to City Council	
4B2	Modify City regulations as needed in order to implement stormwater quality discharge standards as they are developed by the State and the U.S. Environmental Protection	PW	Ongoing	EPA approval; modify LVMC.	
4B2.1	Coordinate with all appropriate entities and agencies in the Valley to establish individual stromwater quality responsibilities and to prepare a funding strategy.	PW	2002		

GEOLOGIC HAZARDS

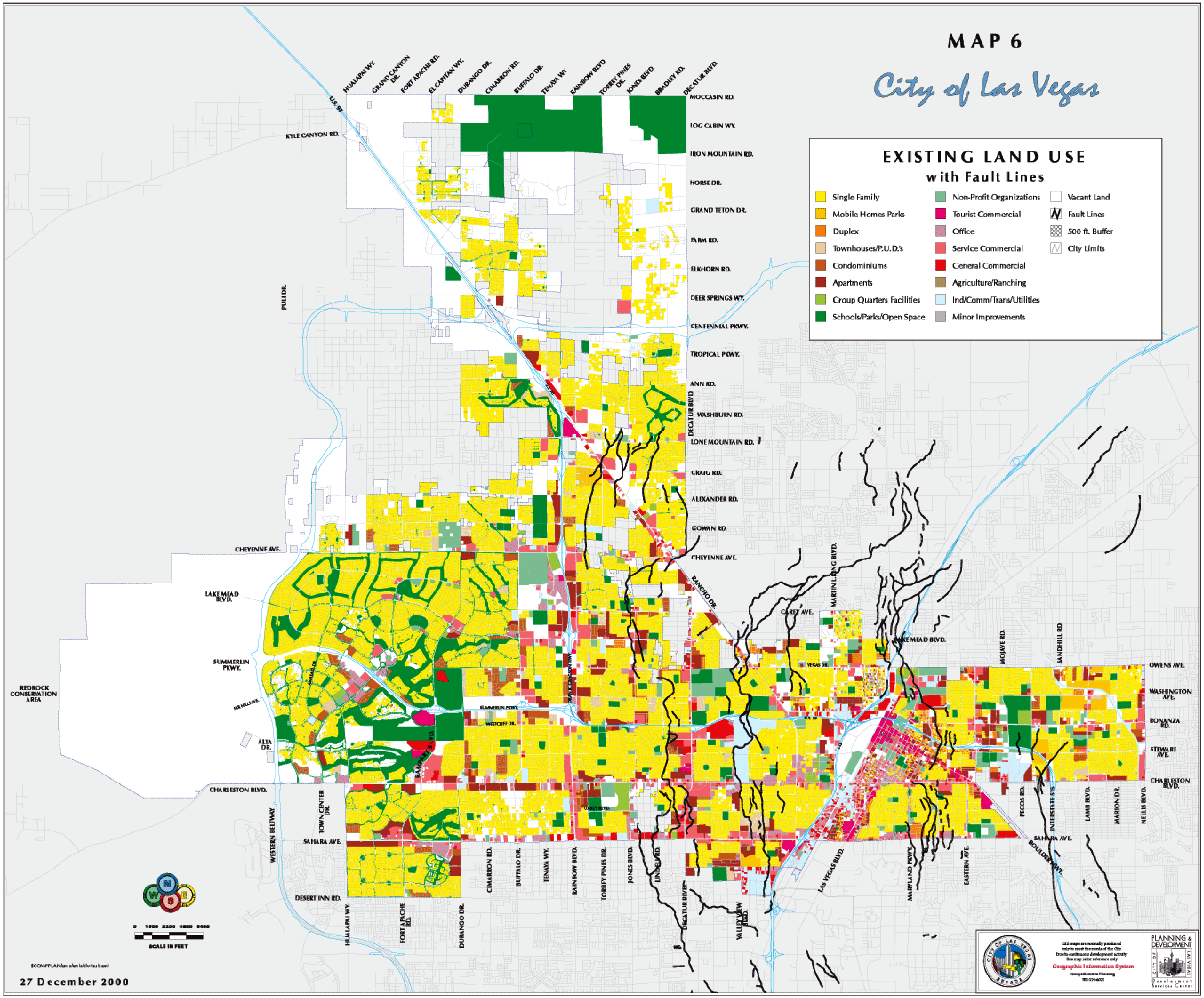
The purpose of this section of the Public Safety Plan is to explain how the services of the City Las Vegas will be incorporated in the accomplishment of public safety in a comprehensive manner as it relates to geologic hazards. Discussion will detail how the City of Las Vegas should interact with other government agencies per Policy 7.3.3 of the 2020 Master Plan.

SEISMICITY/EARTHQUAKE HAZARDS

Seismic activity in the Las Vegas Valley has been and is related to man-made and natural causes. Man-made seismic activity has resulted from underground nuclear testing. It was generally of short duration with the only effect being minor inconvenience to those that experienced the tremor. There is no evidence that any structural damage to local buildings has resulted from nuclear testing. Between the years 1974 and 1976, there were claims that nuclear testing and the resulting subsidence damaged a number of wells in the Northwest part of the valley. The U.S. Department of Energy established a monitoring program in 1976 that included a number of technical surveys such as: level line, tiltmeter, hydrograph and seismic station surveys. The results of these surveys led to the conclusion that land subsidence was occurring continually with no direct correlation to nuclear events. (3)

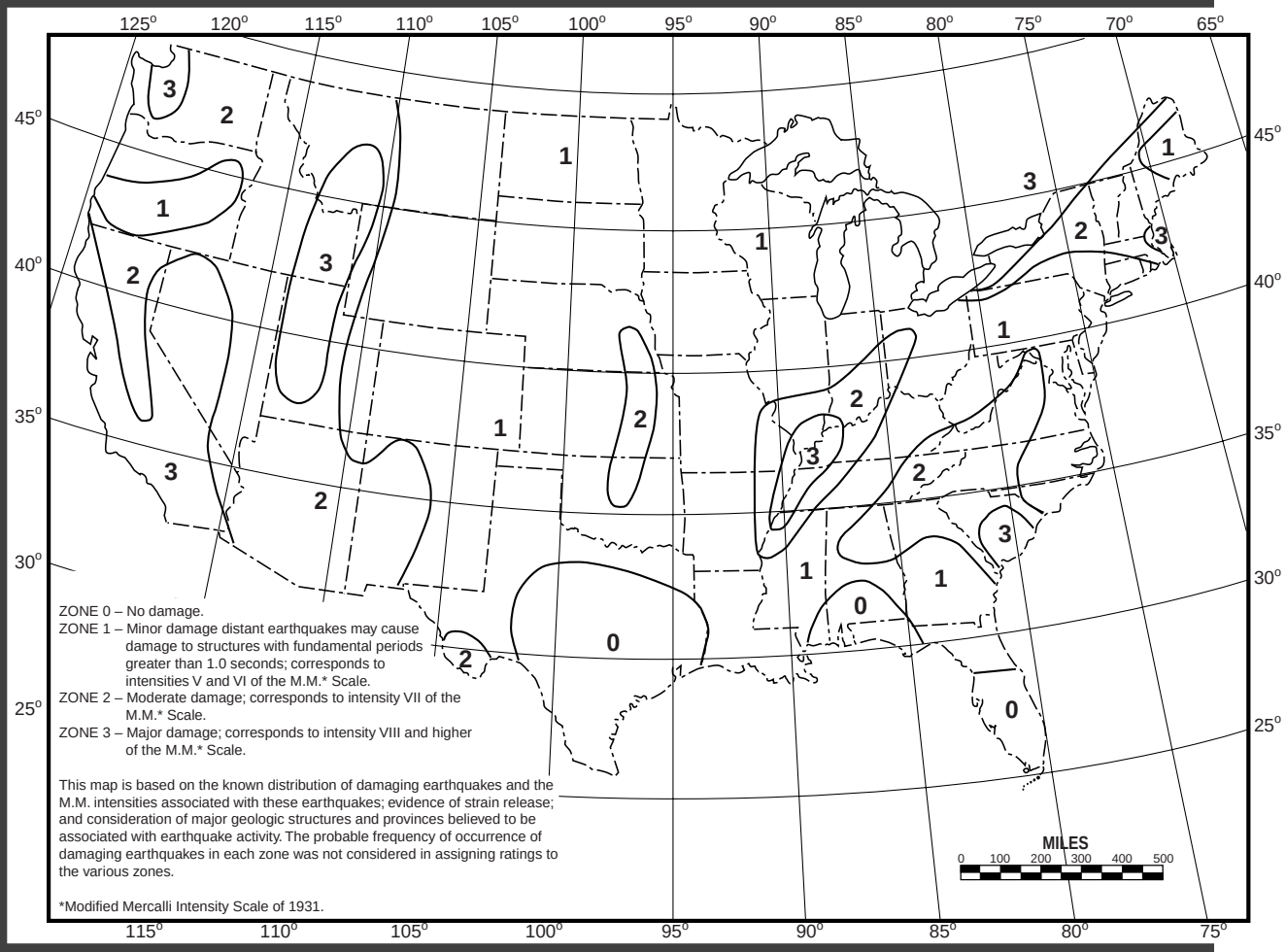
Natural causes of seismic activity are due to shifts in the earth's crust. Faulting results from the separation of part of the of earth's crust in relation to another. Tectonic faulting is found in the Las Vegas Valley and the surrounding mountains. These faults resulted from earth movement that occurred in the middle to late Pleistocene era and traverse the Las Vegas Valley floor in a north-south trending series (Map 6). A good example of a major active tectonic fault is the San Andreas Fault running up the coast of California from San Diego to San Francisco. Movement along this fault has resulted in numerous costly earthquakes.

Major earthquake activity in Nevada is concentrated along a series of faults extending in a northerly direction from the Owen's Valley in California to Winnemucca, with the greatest activity in the Reno-Winnemucca-Tonopah triangle, nearly two hundred miles northwest of the Las Vegas Valley. (4) In Clark County there have been no major earthquakes. However, tremors of intensities ranging between VI and VII on the Modified Mercalli Scale have been felt in the Clark County area as a result of strong earthquakes in west-central Nevada and Southern California. There is also potential danger due to "liquefaction," an earthquake hazard where the


MAP 6
City of Las Vegas
EXISTING LAND USE
with Fault Lines
Single Family
Mobile Homes Parks
Duplex
Townhouses/P.U.D.'s
Condominiums
Apartments
Group Quarters Facilities
Schools/Parks/Open Space
Non-Profit Organizations
Tourist Commercial
Office
Service Commercial
General Commercial
Agriculture/Ranching
Ind/Comm/Trans/Utilities
Minor Improvements
Vacant Land
Fault Lines
500 ft. Buffer
City Limits
MOCCASIN RD.
LOG CABIN WY.
IRON MOUNTAIN RD.
HORSE DR.
GRAND TETON DR.
FARM RD.
ELKHORN RD.
DEER SPRINGS WY.
CENTENNIAL PKWY.
TROPICAL PKWY.
ANN RD.
WASHBURN RD.
LONE MOUNTAIN RD.
CRAIG RD.
ALEXANDER RD.
GOWAN RD.
CHEYENNE AVE.
CAREY AVE.
LAKE MEAD BLVD.
OWENS AVE.
WASHINGTON AVE.
BONANZA RD.
STEWART AVE.
CHARLESTON BLVD.
SAHARA AVE.
DESERT INN RD.
HUALAPAI WY.
GRAND CANYON DR.
FORT APACHE RD.
EL CAPITAN WY.
DURANGO DR.
CIMARRON RD.
BUFFALO DR.
TENAYA WY.
RAINBOW BLVD.
TORREY PINES DR.
JONES BLVD.
BRADLEY RD.
DECATUR BLVD.
U.S. 95
KYLE CANYON RD.
PULI DR.
RANCHO DR.
MARTIN L. KING BLVD.
MOJAVE RD.
SANDHILL RD.
PECOS RD.
INTERSTATE 515
LAMB BLVD.
MARION DR.
NELLIS BLVD.
BOULDER HWY.
EASTERN AVE.
MARYLAND PKWY.
LAS VEGAS BLVD.
VALLEY VIEW BLVD.
LINDELL RD.
WESTERN BELTWAY
TOWN CENTER DR.
RAMPART BLVD.
SUMMERLIN PKWY.
ALTA DR.
REDROCK CONSERVATION AREA
SCALE IN FEET
27 December 2000
PLANNING & DEVELOPMENT
Geographic Information System

support capabilities of the ground give way during intense shaking. Because of these occurrences, the Las Vegas area is classified in Seismic Zone 2B of the Uniform Building Code (UBC) so that construction should remain sound if subjected to Modified Mercalli Scale intensities of VII (see Map 7).

Map 7
Seismic Risk Map of the United States



TOPOGRAPHY AND SOIL TYPES

The Las Vegas Valley area lies in the southwestern part of the Great Basin, within the Basin and Range physiographic province. The Valley is bound on the west by the Spring Mountains, the highest range in Clark County. This range contains Charleston Peak that is the third highest peak in Nevada at 11,918 feet. To the north the valley is bounded by the Desert, Sheep, and Las Vegas Ranges; on the east it is bounded by the Frenchman and Sunrise Mountains; and on the south by the River Mountains and the McCullough Range. (5) Major drainage in the Las Vegas Valley flows through the Las Vegas Wash to Lake Mead. The floor of this basin ranges from 1,800 to 2,500 feet in elevation. The basin floor is bounded on all sides by alluvial fans or aprons with slopes of 50 to 150 feet per mile and pediment surfaces (collectively called piedmont surfaces). Many of these piedmont surfaces are old and occur only as remnants, the most prominent being Whitney and Paradise Mesas in the Southern part of the valley. (6)

The sedimentary formations in the Mountain Ranges consist mainly of limestone and mixtures of sandstone, shale, dolomite, gypsum, and in some places, interceded quartzite. The alluvial fan piedmont is composed of many coalescing fans dissected by numerous drainage channels. The upper portion of the fan piedmont, about 4,500 feet above sea level, is made up of poorly sorted gravelly, cobbly, and stony sand deposits that grade to finer textured material near the valley floor. The basin floors are depositional areas of lake-laid silt and clay and younger alluvial deposits. (7)

Soil formation and deposit characteristics are an important consideration in land use planning and land development decisions. Location of soil types can be used to identify the potentials and limitations of an area for specific land uses and to help prevent construction failures caused by particular soil properties, i.e., slope, depth, drainage, and physical characteristics. For example, impervious soil horizons are an important factor in desert flooding. Construction costs for building roads and preparing building sites are higher in shallow soils overlaying hardpan due to the need for heavy equipment such as backhoes, rippers, or trenching machines to penetrate the hardpan. Occasionally, blasting is necessary. Soils that are moderately to strongly alkaline can cause corrosive chemical reactions to uncoated steel and concrete. The shrink/swell potential of soils is a factor in soil movement that could damage foundations (see also discussion on subsidence, section 5.3, specifically "collapsible soils").

Consideration of the impacts of adverse soil and deposit characteristics can be conducted through the development review process. The review of building plans for geologic hazards, the

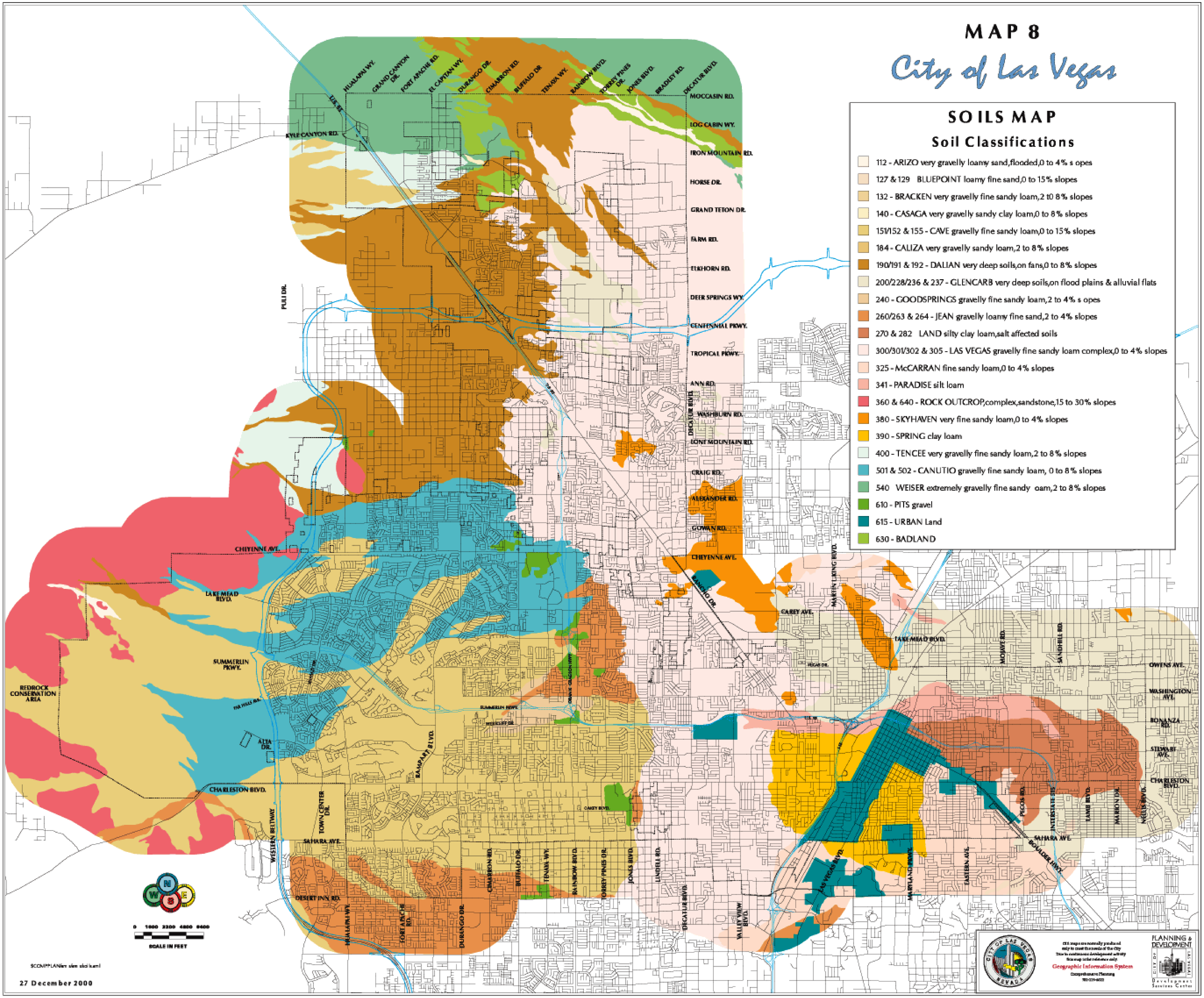

MAP 8
City of Las Vegas
SOILS MAP
Soil Classifications
112 - ARIZO very gravelly loamy sand,flooded,0 to 4% s opes
127 & 129 BLUEPOINT loamy fine sand,0 to 15% slopes
132 - BRACKEN very gravelly fine sandy loam,2 t0 8% slopes
140 - CASAGA very gravelly sandy clay loam,0 to 8% slopes
151/152 & 155 - CAVE gravelly fine sandy loam,0 to 15% slopes
184 - CALIZA very gravelly sandy loam,2 to 8% slopes
190/191 & 192 - DALIAN very deep soils,on fans,0 to 8% slopes
200/228/236 & 237 - GLENCARB very deep soils,on flood plains & alluvial flats
240 - GOODSPRINGS gravelly fine sandy loam,2 to 4% s opes
260/263 & 264 - JEAN gravelly loamy fine sand,2 to 4% slopes
270 & 282 LAND silty clay loam,salt affected soils
300/301/302 & 305 - LAS VEGAS gravelly fine sandy loam complex,0 to 4% slopes
325 - McCARRAN fine sandy loam,0 to 4% slopes
341 - PARADISE silt loam
360 & 640 - ROCK OUTCROP,complex,sandstone,15 to 30% slopes
380 - SKYHAVEN very fine sandy loam,0 to 4% slopes
390 - SPRING clay loam
400 - TENCEE very gravelly fine sandy loam,2 to 8% slopes
501 & 502 - CANUTIO gravelly fine sandy loam, 0 to 8% slopes
540 WEISER extremely gravelly fine sandy oam,2 to 8% slopes
610 - PITS gravel
615 - URBAN Land
630 - BADLAND
HUALAPAI WY.
GRAND CANYON DR.
FORT APACHE RD.
EL CAPITAN WY.
DURANGO DR.
CIMARRON RD.
BUFFALO DR.
TENAYA WY.
RAINBOW BLVD.
TORREY PINES DR.
JONES BLVD.
BRADLEY RD.
DECATUR BLVD.
MOCCASIN RD.
LOG CABIN WY.
IRON MOUNTAIN RD.
HORSE DR.
GRAND TETON DR.
FARM RD.
ELKHORN RD.
DEER SPRINGS WY.
CENTENNIAL PKWY.
TROPICAL PKWY.
ANN RD.
WASHBURN RD.
LONE MOUNTAIN RD.
CRAIG RD.
ALEXANDER RD.
GOWAN RD.
CHEYENNE AVE.
KYLE CANYON RD.
PULI DR.
CHEYENNE AVE.
LAKE MEAD BLVD.
SUMMERLIN PKWY.
REDROCK CONSERVATION AREA
ALTA DR.
CHARLESTON BLVD.
WESTERN BELTWAY
TOWN CENTER DR.
SAHARA AVE.
RAMPART BLVD.
DESERT INN RD.
HUALAPAI WY.
FORT APACHE RD.
DURANGO DR.
CIMARRON RD.
BUFFALO DR.
TENAYA WY.
RAINBOW BLVD.
TORREY PINES DR.
JONES BLVD.
LINDELL RD.
DECATUR BLVD.
VALLEY VIEW BLVD.
RANCHO DR.
CAREY AVE.
MARTIN L KING BLVD.
LAKE MEAD BLVD.
VEGAS DR.
MOJAVE RD.
SANDHILL RD.
OWENS AVE.
WASHINGTON AVE.
BONANZA RD.
STEWART AVE.
CHARLESTON BLVD.
PECOS RD.
INTERSTATE 515
LAMB BLVD.
NELLIS BLVD.
SAHARA AVE.
BOULDER HWY.
EASTERN AVE.
MARYLAND PKWY.
LAS VEGAS BLVD.
SCALE IN FEET
Geographic Information System
PLANNING & DEVELOPMENT
27 December 2000

Table 5
Soil Impacts

Soil Name	Typical Map Symbol	Shallow Evcuations	Risk of Corrosion Uncoated Steel	Concrete	Shrink- Swell Potential
Arizo	112	Severe: Cutbacks Cave	High	Low	Low
Cave	152	Severe: Cemented Pan, Cutbanks cave	High	Low	Low
Cave	155	Severe: Cemented Pan, Cutbanks cave	High	Low	Low
Dalian	190	Slight	High	Low	Low
Dalian	191	Slight	High	Low	Low
Dalian-McCullough	192	Slight	High	Low	Low
Glencarb	200	Slight	High	Moderate	Low-Moderate
Glencarb	236	Slight	High	High	Low-Moderate
Glencarb	237	Moderate: Cemented Pan	High	Low	Low-Moderate
Goodsprings	240	Severe: Cemented Pan, Cutbanks cave	High	Low	Low
Jean	260	Severe: Cutbacks Cave	High	Low	Low
Jean	263	Severe: Cutbacks Cave	High	Low	Low
Jean	264	Severe: Cutbacks Cave	High	Low	Low
land	270	Moderate: too clayey, wetness	High	High	Low-Moderate
land	282	Moderate: too clayey, wetness	High	High	Low-Moderate
Las Vegas	300	Severe: Cemented Pan	High	High	Low
Las Vegas	301	Severe: Cemented Pan	High	High	Low-Moderate
Las Vegas Destazo	305	Severe: Cemented Pan	High	High	Low-Moderate
McCarran	325	Slight	High	High	Low
Paradise	341	Moderate: wetness			Low
St Thomas	360	Severe: depth to rock, large stones, slope	High	Low	Low
Skyhaven	380	Severe: Cemented Pan	High	High	Low-Moderate
Spring	390	Slight	HIgh	High	Moderate
Tencee	400	Severe: Cemented Pan	High	Low	Low
Canutio	501	Moderate: large stones	High	Low	Low
Canutio-Cave	502	Moderate: large stones	High	Low	Low
Weiser	540	Slight	High	Low	Low
Pits-Gravel	610	N/A	N/A	N/A	N/A
Urban land	615	N/A	N/A	N/A	N/A
Badland	630	N/A	N/A	N/A	N/A

requirement of a soils engineering report for non-residential development plans, and a geo-technical investigation report on any housing development within 500 feet of a documented fault or fissure can all be incorporated in the current plot / site plan review process currently being conducted by City staff.

The City of Las Vegas should consider a policy that discourages development where seismic problems cannot be mitigated and encourages amendments to the Land Use Plan to properly reclassify those areas unsuitable for development because of geologic conditions. A subsidence district could be designated so monitoring can be conducted and mitigation measures determined and carried out when necessary.

Beginning with the data available from the Clark County Building Department and in cooperation with the other neighboring governments and agencies, the city should begin to maintain and periodically update maps of documented areas of collapsible soils, subsidence, faulting and fissuring within the city limits. The Department should make available to the public information concerning documented areas of seismic hazard, subsidence, and poor soil conditions.

Table 5, Soil Impacts, summarizes individual soil type and Map 8, Soils Map, indicates where these soils are within city limits. The information presented in the table and maps are intended as a general representation and not for the purpose of determining hazards to construction. For example, use of this information does not substitute the need for site-specific soils analysis. The following terms and characteristic ratings are used in the table.

- *Shallow Excavations:*
  Rated by the ease of digging, filling, and compacting soils for trenches or holes dug to a maximum depth of five to six feet. The ease of digging is affected by depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The limitations are slight if soil properties and site features are generally favorable for excavation; moderate if soil properties and site features are not favorable and special planning, design, or maintenance is needed to overcome or minimize the limitations; and severe if soil properties or site features are so unfavorable or so difficult to overcome that special design; significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where soil limitations are severe.

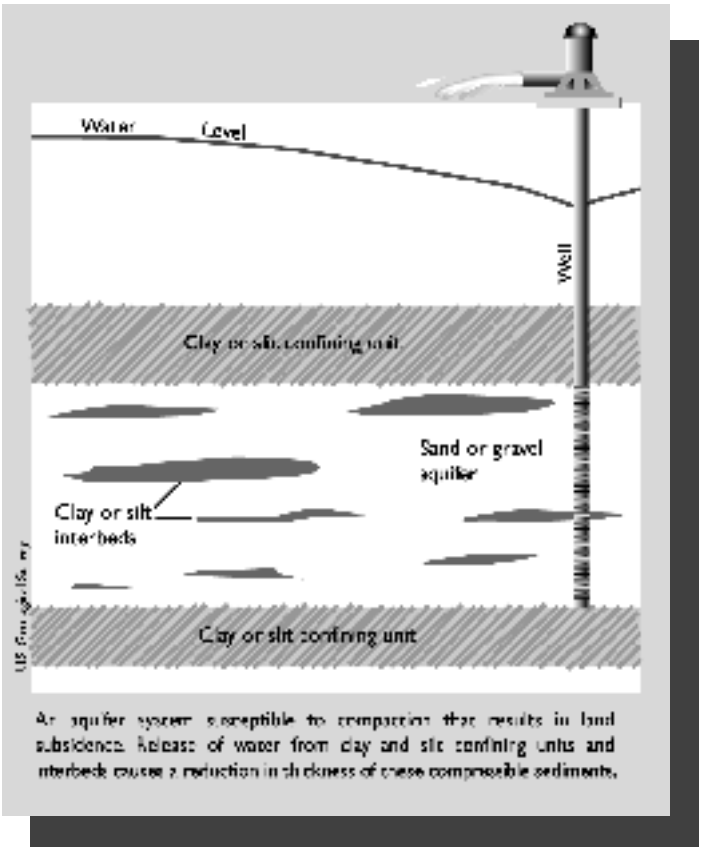
- *Risk of Corrosion:*
  Pertains to potential soil-induced electrochemical or chemical action that dissolves or weakens uncoated steel or concrete.

For uncoated steel, the risk of corrosion, expressed as low, moderate, or high, is based on soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil. For concrete, the risk of corrosion is also expressed as low, moderate, or high. It is based mainly on the sulfate and sodium content, texture, moisture content, and acidity of the soil. Special site examination and design should be required if the combination of factors creates a severe corrosion environment.

- *Shrink-Swell Potential:*
  The potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed. Shrink-swell potential classes are based on the change in length or diameter of an unconfined clod (of soil) as moisture content is increased from air-dry to saturation. The change is based on the shrinkage or expansion of less than 2 millimeters in diameter. The classes are low, a change of less than 3 percent; moderate, 3 to 6 percent; and high, more than 6 percent. Very high, greater than 9 percent, is sometimes used.

SUBSIDENCE

Land subsidence, or the lowering of the earth's surface, can be due to natural causes or man-made processes. These causes are grouped into two categories: endogenic and exogenic subsidence. (8) Endogenic subsidence occurs within the earth and is due to tectonism, volcanism, and continental drift. Exogenic subsidence occurs mainly at the earth's surface and can result from natural causes as well as induced by the activities of man.



An aquifer system susceptible to compaction that results in land subsidence. Release of water from clay and silt confining units and interbeds causes a reduction in thickness of these compressible sediments.

Table 6
Specific Cases of Damage Caused by Subsidence

Map ID	Tyoe of Damage	Location	Date of Occurance	Remarks
1	Protruding well	Las Vegas Valley Water District Well Field No. 5	By 1963 As of 1978	1.5 ft. of protrusion 4 ft. of protrusion of well head, casing pumping in 1971; pumped much sand.
2	Protruding well	City of N. Las Vegas Stocker (west tank) Well	1936- 1963 1963- 1969	3 ft. of protrusion 6 in. protrusion; casing replaced in 1969; shows no present protrusion.
3	Protruding well	City of North Las Vegas Losee Well	1968- 1971 1968	7 in. protrusion; casing replaced in 1969; shows no present protrusion. Ruptured well line.
4	Protruding well	City of North Las Vegas Tonopah Well	Unknown	
5	Protruding well	City of North Las Vegas Tonopah Well	Unknown	Presently shows 6 in. of protrusion with broken well pad.
6	Protruding well	Nellis AFB area Nellis Well No. 4		Well head and pad show 4 in. of protrusion.
7	Protruding well	City of North Las Vegas LVVWD Well No. 57	As of 1978	2.5 ft. protrusion of casin; well abandoned.
8	Warping of railroad tracks	UPRR at Owens Ave.	1961	5 in. gradual displacement; 6 in. rapid displacement associated with fissuring.
9	Damaged house	Harrison and Owens	1961	2 in. rupture in house believed result of fissuring.
10	Damaged house	Near Craig Ranch Country Club	Unknown	Reportly large separation
11	Damaged house	Twin Lakes Drive between Bonanza Rd. and Washington Ave.	Pre 1974	Two residences damaged; extent of damage unknown; online with fussures from LVVWD well field.
12	Damaged house	Adams St. at Las Vegas Blvd.	Pre 1963	Result of movement on scarp III.
13	Popped windows in houses, cracked driveways, broken curbs	Twin Lakes Drive area	Pre 1965	Attributed to movement on scarp II.
14	Cracked pavement and curbs	Between Owens and Harrison Aves. and A and B Sts.	Pre 1970	Accompanied renewed fissuring.

Table 6
Specific Cases of Damage Caused by Subsidence, continued

Map ID	Type of Damage	Location	Date of Occurance	Remarks
15	Cracked pavement	Commerce St. near Losee Well	Pre 1971	
16	Cracked pavement	Craig Rd near Nellis AFB well field	Unknown	
17	Cracked asphalt in playground Well failures	Gilbert School in North Las Vegas Strip area	Unknown 1970- 1974	Occurs where fissure extends beneath pavement. At least two failures due to sheared casing.
18	Damaged wells	Northwest of North Las Vegas Airport	1974- 1976	15 claims or complaints of: decreased productivity, turpid or sandy water, and deformation and shearing of casing.
19	Ruptured water mains; damaged pavement	Charleston Blvd. at Maryland Pkwy.	1964	$10,000 damage reportly related to movement on scarp III.
20	Ruptured water main	Highland Ave. at Hastings Ave.	1964	$2,000 damage
21	Ruptured water main	1626 Thelma Ln	1964	$1,500 damage
22	Ruptured water main	12th St. between Bonneville and Clark Aves.	1964	$1,500 damage
23	Ruptured water main	1128 Francis Ave	1964	$14,000 damage
24	Ruptured water main	400 E. Garces Ave	1964	$12,000 damage
25	Ruptured water mains; damaged pavement; cracked house	Near Owens Ave and UPRR	1961	Related to fissuring
26	Warped sewage line	Charleston Blvd. Between Eastern Ave. and Pecos Rd.	Unknown	Differential movement attributed to land subsidence; lowered flow gradient required construction of new line.
27	Ruptured gas line	Washington Ave. near Twin Lakes Dr.	Unknown	Two reported breaks attributed to movement on scarp II.
28	Ruptured swimming pool	Near Commerce St. and Losee Rd.	Unknown	Concrete pool back rotated and cracked; attributed to movement on scarp III.
29	Buckled drainage channel	In Flamingo Wash	Pre 1974	

Source: Appendix, 1992 City of Las Vegas General Plan

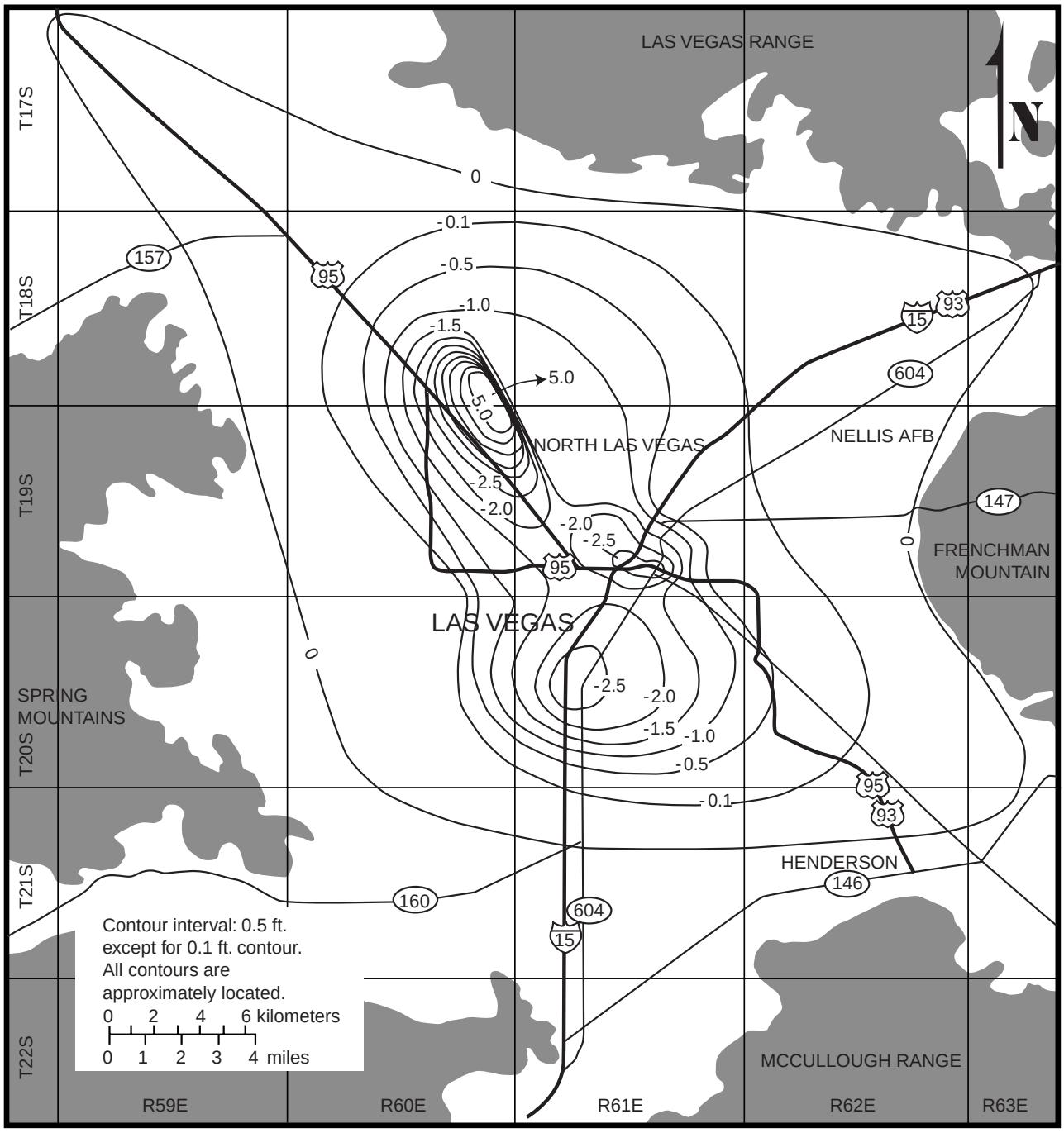
Exogenic subsidence is basically the result of a loss of support. There are three processes that could result in a loss of support. First, loss of support can be caused by fluid extraction as in the case of groundwater withdrawal. Second, loss of support on a regional scale can be caused by an increase of loading from the weight of a body of water such as a lake. A third process that could cause a loss of support is the adding water to, or saturating, of a collapsible soil that has a loose grain structure. According to Don Helm, Research Hydrogeologist, Nevada Bureau of Mines and Geology (NBMG), "In a desert environment, some soils have never been completely saturated before and the grains touch each other in a loose and sometimes flimsy interconnected structure. Water essentially lubricates them and they collapse possibly under their own weight and almost certainly if in addition they have been supporting a house or some other structure." This last process is referred to as "hydrocompaction".

Regional subsidence in the Las Vegas Valley was due to the creation of Lake Mead. The weight of the lake and its sediment load is over forty million tons. This weight along with tectonic activity already having occurred in the area is thought to have tilted the Las Vegas Valley four to five inches. However, this regional subsidence is thought to have had little effect on subsidence related problems in the Las Vegas Valley. These tend to be localized. Groundwater withdrawal is thought to be the most common reason for localized ground subsidence in the Las Vegas Valley.

Land subsidence in the Las Vegas Valley has been studied for more than fifty years. In 1978, a panel of U. S. Geological Society (USGS) scientists investigated the potential hazard posed by the subsidence problem concluding that a potential hazard for fissuring and surface faulting existed due to groundwater withdrawal in the valley. The USGS released a Notice of Potential Hazard in accordance with the Disaster Relief Act of 1974. As a supplement to the USGS Notice of Potential Hazard, NBMG prepared a comprehensive overview and analysis of subsidence in the Las Vegas Valley. The report was completed in 1981. This report has been and should continue to be updated by several research groups with NBMG serving as the lead agency. Table 6, Specific Cases of Damage Caused by Subsidence, is a summary of the report and documents the effects of subsidence valley wide. Map 10 details the location of the cases and the variations of soil elevation due to subsidence.

Parallel to this update, the NBMG is spearheading an integrated modeling research project within the University System, known as Subsidence Modeling and Prediction. Map 9 shows those areas most susceptible to subsidence. Emphasis is on the poorly understood phenomenon of horizontal movement and related fissuring. Participants in the study intend to establish a reliable method of predicting fissure initiation and propagation.

Map 9
Subsidence Potential



It is important to understand the distinction between "fault movement" and "fissure movement". Fault movement is associated with the release of natural forces, while fissure movement is associated with hydraulically driven forces associated with groundwater withdrawal. Fissures tend to occur near faults for very good reasons, but what causes fissure movement is very different from what causes fault movement. Thus, one can understand why exploring the causes of groundwater withdrawal related fissures and possibly discovering a method of making accurate predictions about when and where they should occur is very important in the Las Vegas Valley. The results of the study should provide a significant management tool for government agencies, public utilities and private industry in order to avoid or mitigate the potential hazards of subsidence.

According to ongoing analysis, subsidence is continuing at a rate similar to that found during the 1950s and 1960s when pumpage of groundwater was at its peak. However, the magnitude and

location of the subsidence effects varies according to the hydraulic connection between geologic strata underlying areas of groundwater withdrawal. Coarse grain deposits (sand and gravel) are less susceptible to vertical compaction and recover well when recharged. In contrast, fine-grain

deposits (silts and clays) are highly compressible and are not as likely to recover from groundwater withdrawal when recharge begins. Soil samples taken from basin-fill sediments

show that the most compressible deposits are located in the center of the basin near Las Vegas (Map 10). The Subsidence Modeling and Prediction research plan mentioned above should help identify those areas susceptible to subsidence.

Map 10 also shows areas of the Las Vegas Valley that have experienced land subsidence due to the effects of groundwater withdrawal. Consequences of the valley floor sinking include evidence of new fissuring and possible spreading of existing faults and fissures. In most cases, these were originally caused by a combination of tectonic activity and the natural dewatering and subsequent compaction of basin-fill sediments during the warm, dry Pleistocene interglacial period.

Not all damage of this nature is caused by groundwater withdrawal, however. According to geologists and building officials there are localized problems associated with different types of soils and sometimes-poor construction techniques. Updates of the 1981 subsidence report should contain a more thorough analysis of these differences. In the meantime, some governmental entities have initiated a policy that discourages the building of structures on land

already documented as a subsidence area. For example, the Clark County School District currently rejects new school site locations if they are located in areas where subsidence damage has occurred in the past. Sites located on or near fissures caused by groundwater withdrawal would be expensive to build on and maintenance costs could be higher over time due to the resulting structural changes in the building. The Las Vegas office of the Department of Housing and Urban Development issued new guidelines requiring anyone building within 500 feet of a mapped fissure or fault to perform a geotechnical study as a condition for receiving federal assistance (see Appendix 11.1 and Map 11). The City of Las Vegas Department of Public Works presently requires a soils investigation on any new construction and depending on the outcome of that report construction recommendations will be stipulated.

SUMMARY

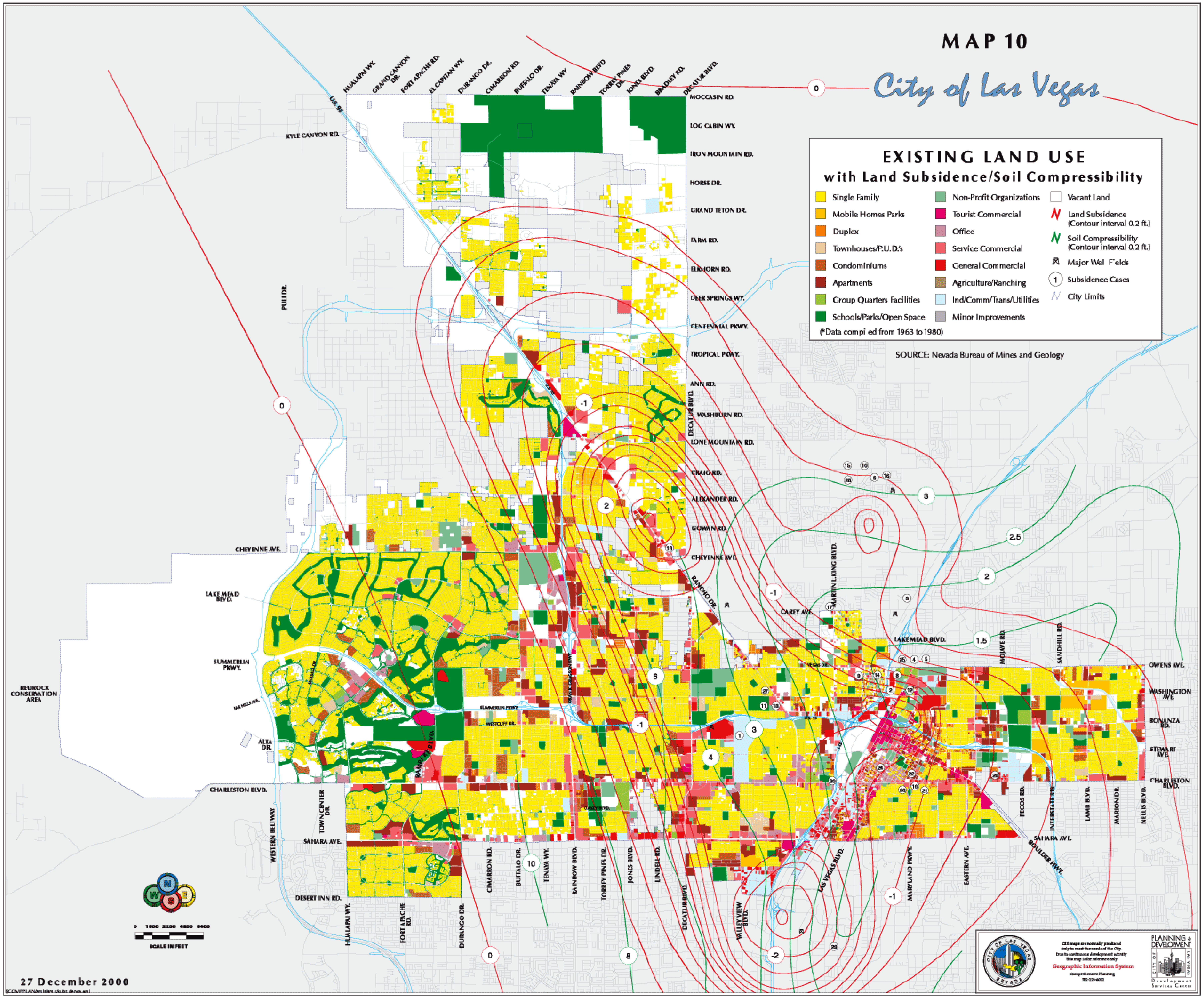
The subsidence problem will continue to occur as long as groundwater withdrawal exceeds annual recharge, natural or injected. The most damaging result will be the spreading of existing fissures and the likely formation of new ones. These phenomena will make such things as the enforcement of adequate construction regulations necessary. It will also require consideration of land use density restrictions on susceptible geographic areas. The NBMG study referenced above should be used by the City of Las Vegas to map high hazard areas. This can be done with current studies of subsidence as shown on Map 10. Then, policy can be made regarding the safe use of the land.

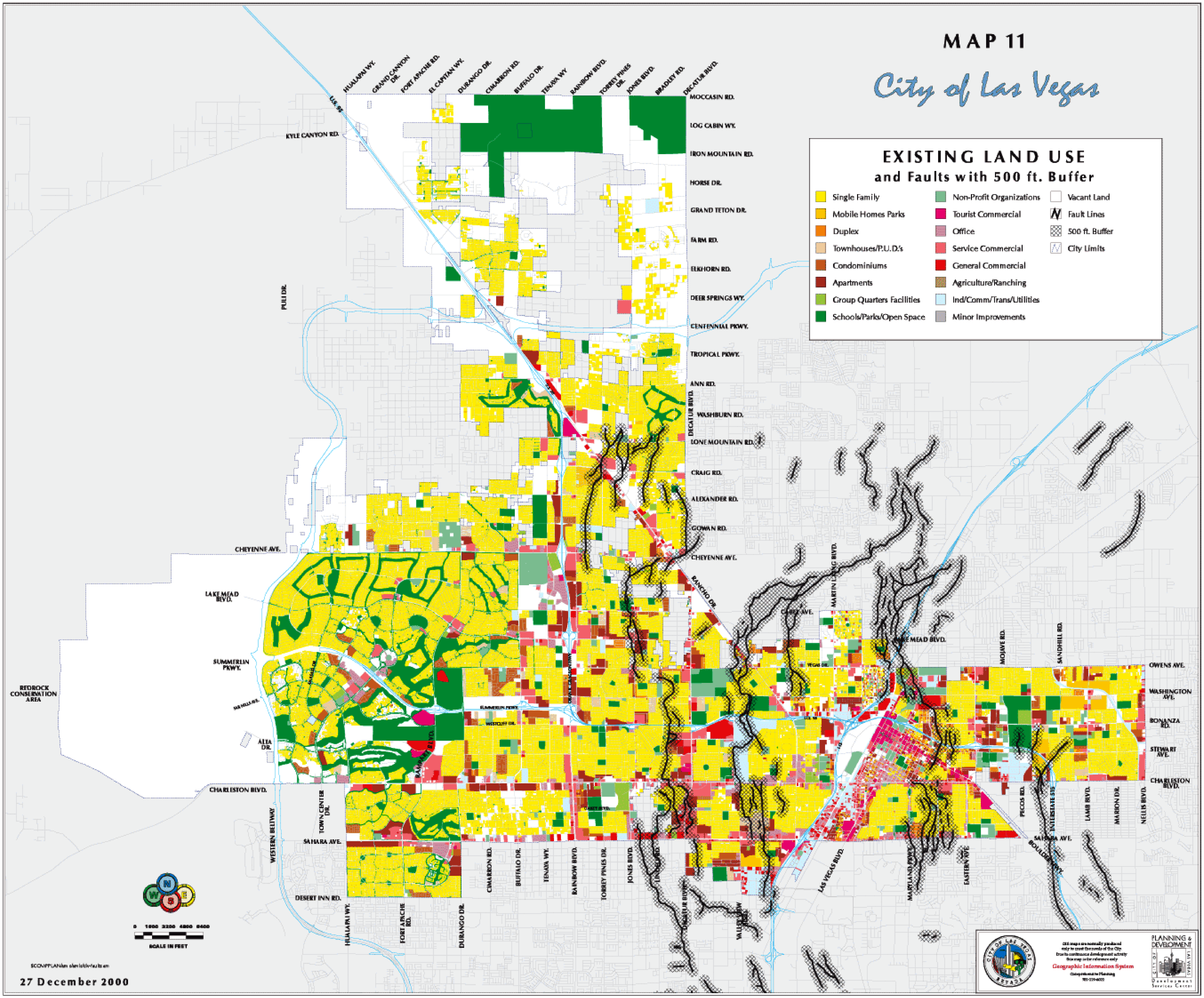
Seismic activity in the Las Vegas Valley has had significance in a geologic sense and in geologic time. Current building practices have been adequate to withstand seismic activity both man-induced through nuclear testing and natural from earthquakes. Research intending to update local seismic information may result in more stringent building standards. The pivotal issue in the valley is dealing with certain geologic deposits that are susceptible to horizontal movement and fissuring that may cause structural damage to buildings. Efforts to stabilize groundwater withdrawal practices should be prioritized locally and through State level legislation.

ISSUES

Existing in the Las Vegas Valley are soil and geologic conditions that are susceptible to subsidence problems. Continued withdrawal of groundwater in excess of annual recharge contributes substantially to the subsidence problem. In order to mitigate this phenomenon, efforts to stabilize groundwater withdrawal practices should have higher priority locally than through State level legislation. In the meantime, research, conducted and coordinated by an interagency body such as the Southern Nevada Regional Planning Coalition, will be funded that should develop prediction methods (especially of fissuring events) and continue to update data that can be used to determine development opportunities and constraints due to geologic hazards such as seismic hazards, collapsible soils, subsidence and related groundwater management practices in the Las Vegas Valley.

Natural flowing springs and artesian wells were once a fairly common sight in the Las Vegas valley area, but with the high demands for water created by an rapidly growing community has come the depletion of the water table, contributing to the occurrance of ground subsidence around the valley


MAP 10
City of Las Vegas
EXISTING LAND USE
with Land Subsidence/Soil Compressibility
Single Family
Mobile Homes Parks
Duplex
Townhouses/P.U.D.'s
Condominiums
Apartments
Group Quarters Facilities
Schools/Parks/Open Space
Non-Profit Organizations
Tourist Commercial
Office
Service Commercial
General Commercial
Agriculture/Ranching
Ind/Comm/Trans/Utilities
Minor Improvements
Vacant Land
Land Subsidence (Contour interval 0.2 ft.)
Soil Compressibility (Contour interval 0.2 ft.)
Major Wel Fields
Subsidence Cases
City Limits
(*Data compi ed from 1963 to 1980)
SOURCE: Nevada Bureau of Mines and Geology
MOCCASIN RD.
LOG CABIN WY.
IRON MOUNTAIN RD.
HORSE DR.
GRAND TETON DR.
FARM RD.
ELKHORN RD.
DEER SPRINGS WY.
CENTENNIAL PKWY.
TROPICAL PKWY.
ANN RD.
WASHBURN RD.
LONE MOUNTAIN RD.
CRAIG RD.
ALEXANDER RD.
GOWAN RD.
CHEYENNE AVE.
CAREY AVE.
LAKE MEAD BLVD.
OWENS AVE.
WASHINGTON AVE.
BONANZA RD.
STEWART AVE.
CHARLESTON BLVD.
SAHARA AVE.
DESERT INN RD.
KYLE CANYON RD.
REDROCK CONSERVATION AREA
SUMMERLIN PKWY.
ALTA DR.
HUALAPAI WY.
FORT APACHE RD.
DURANGO DR.
CIMARRON RD.
BUFFALO DR.
TENAYA WY.
RAINBOW BLVD.
TORREY PINES DR.
JONES BLVD.
DECATUR BLVD.
RANCHO DR.
MARTIN L.KING BLVD.
LAS VEGAS BLVD.
MARYLAND PKWY.
EASTERN AVE.
PECOS RD.
LAMB BLVD.
NELLIS BLVD.
BOULDER HWY.
WESTERN BELTWAY
TOWN CENTER DR.
SCALE IN FEET
PLANNING & DEVELOPMENT
Geographic Information System
27 December 2000



MAP 11
City of Las Vegas
EXISTING LAND USE
and Faults with 500 ft. Buffer
Single Family
Mobile Homes Parks
Duplex
Townhouses/P.U.D.'s
Condominiums
Apartments
Group Quarters Facilities
Schools/Parks/Open Space
Non-Profit Organizations
Tourist Commercial
Office
Service Commercial
General Commercial
Agriculture/Ranching
Ind/Comm/Trans/Utilities
Minor Improvements
Vacant Land
Fault Lines
500 ft. Buffer
City Limits
HUALAPAI WY.
GRAND CANYON DR.
FORT APACHE RD.
EL CAPITAN WY.
DURANGO DR.
CIMARRON RD.
BUFFALO DR.
TENAYA WY.
RAINBOW BLVD.
TORREY PINES DR.
JONES BLVD.
BRADLEY RD.
DECATUR BLVD.
MOCCASIN RD.
LOG CABIN WY.
IRON MOUNTAIN RD.
HORSE DR.
GRAND TETON DR.
FARM RD.
ELKHORN RD.
DEER SPRINGS WY.
CENTENNIAL PKWY.
TROPICAL PKWY.
ANN RD.
WASHBURN RD.
LONE MOUNTAIN RD.
CRAIG RD.
ALEXANDER RD.
GOWAN RD.
CHEYENNE AVE.
U.S. 95
KYLE CANYON RD.
PULI DR.
LAKE MEAD BLVD.
SUMMERLIN PKWY.
REDROCK CONSERVATION AREA
ALTA DR.
CHARLESTON BLVD.
WESTERN BELTWAY
TOWN CENTER DR.
SAHARA AVE.
DESERT INN RD.
RAMPART BLVD.
RANCHO DR.
CAREY AVE.
MARTIN LUTHER KING BLVD.
LAKE MEAD BLVD.
MOJAVE RD.
SANDHILL RD.
OWENS AVE.
WASHINGTON AVE.
BONANZA RD.
STEWART AVE.
CHARLESTON BLVD.
PECOS RD.
INTERSTATE 515
LAMB BLVD.
MARION DR.
NELLIS BLVD.
SAHARA AVE.
BOULDER HWY.
EASTERN AVE.
MARYLAND PKWY.
LAS VEGAS BLVD.
VALLEY VIEW BLVD.
DECATUR BLVD.
CIMARRON RD.
BUFFALO DR.
TENAYA WY.
RAINBOW BLVD.
TORREY PINES DR.
JONES BLVD.
HUALAPAI WY.
FORT APACHE RD.
DURANGO DR.
N
W
E
S
SCALE IN FEET
27 December 2000
Geographic Information System
PLANNING & DEVELOPMENT

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: The City should participate in the protection of the environmental quality of the Las Vegas valley and to promote the conservation of our natural resources.

Objective 5A: The City should preserve life and property from geologic hazards such as seismic hazards, subsidence and related groundwater management practices, and poor soil conditions such as collapsible soils.

Policy 5A1: Building and Safety should continue the review of building plans for geologic hazards, i.e., collapsible soils, faults and fissuring, and subsidence.

Program 5A1.1: Public Works and Information Technologies should continue to maintain and periodically update maps of documented areas of collapsible soils, subsidence, faulting and fissuring with latest data available from research.

Program 5A1.2: Building and Safety should implement the requirement of a geotechnical investigation report on any housing development within 500 feet of a documented fault or fissure. The report should follow current HUD guidelines found in Appendix 11.1, "HUD Guidelines for Housing Developments Subject to Potential Ground Subsidence".

Program 5A1.3: Public Works should continue to require a soils engineering report on non-residential development plans as part of the development review process in order to document subsidence activity or other adverse conditions and enforce appropriate mitigation.

Policy 5A2: In cooperation neighboring agencies, the City should develop policy which shall include, but not be limited to, discouraging development where seismic problems cannot be mitigated, and prepare land use amendments to properly reclassify areas.

Program 5A2.1 As part of development review the Planning and Development Department should review applications in terms of seismic problems.

Program 5A2.2 By amending the Land Use Plan the City should discourage development where seismic problems cannot be mitigated.

Program 5A2.3 The Planning and Development Department, upon the determination of unsuitable areas of development because of seismic issues should amend the Land Use Plan to prevent the development of such areas.

Policy 5A3: The City should establish a subsidence district and make appropriate amendments to the Land Use Element of the General Plan.

Policy 5A4: Public Works and Building and Safety should make available, to the public, information concerning documented areas of seismic hazard, subsidence, and poor soil conditions.

EVALUATIONS AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific programs, and
- tool for further developing work programs.

The following abbreviations apply to each Evaluation and Implementation Matrix

City

BS Building and Safety
CM City Manager
PD Planning and Development
PW Public Works

Other Agencies/Jurisdictions

ENGR State Engineer
WRMI Water Resource Management, Inc.

Table 7
Evaluation and Implementation Matrix : Geologic Hazards

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
5A1	Review building plans for geologic hazards, i.e., collapsible soils, faults, fissuring, and subsidence.	BS	Ongoing		i.e., post tension slabs in developments located in hazard areas.
5A1.1	Maintain and periodically update maps of documented areas of collapsible soils, subsidence, faulting and fissuring with latest data available from research.	PD	Ongoing	GIS database and Map	Use GIS map to determine areas subject to HUD guidelines.
5A1.2	Require a geotechnical investigation report on any housing development within 500 feet of a documented fault or fissure. The report should follow current HUD guidelines for reprt content.	BS	2002	Use report submitted during development review to determine necessary mitigation.	
5A1.3	Require soils engineering report on non-residential development plans in order to document subsidence activity or other adverse condition and enforce ppropriate mitigation.	PW	Ongoing	Use report to determine suitability of development.	
5A2.1	Develop policy as part of the Master Plan, which shall include, but not be limited to, discouraging development where seismic problems cannot be mitigated and land use amendments to properly reclassify.	PD, PW, BS	2001	Policy within the Master Plan.	
5A4	Make available to the public information concerning documented areas of seismic hazard, subsidence, and poor soil conditions.	PD, BS	2001	Maps, brochures	

NOISE

The purpose of this section of the Public Safety Plan is to explain how the services of the City Las Vegas will be incorporated in the accomplishment of public safety in a comprehensive manner as it relates to geologic hazards. Discussion will detail how the City of Las Vegas should establish and enforce maximum acceptable levels of noise within residential and public areas per Policy 7.3.4 of the 2020 Master Plan.

INTRODUCTION

The Las Vegas metropolitan area's rapid growth and its accompanying increase in roadways and air traffic have resulted in urban noise levels that are perceived as a threat to the public's quality of life and possibly to the community's health and welfare. In addition, land uses that place noise-producing activities adjacent to residential or other noise sensitive uses increase the number of noise conflicts in the region.

Guidelines developed by several federal agencies including the Federal Highway Administration, the Federal Aviation Administration, the Environmental Protection Agency and the Department of Housing and Urban Development stipulate that residential land use sound levels not exceed 45-55 decibels. Schools, hospitals, lodging, and certain recreational facilities are "noise sensitive uses" which should be protected from a variety of environmental and public problems.

Heavy traffic noise is a nuisance concern for residential areas that abutt main traffic corridors

The decibel (dB) is a unit for measuring the volume of a sound. A rating scale, dB (A), was devised to measure sound relative to the sensitivity of the human ear. The dB (A) scale is logarithmic so an increase of ten decibels is a tenfold increase in sound energy. However, measuring sound does not necessarily determine what actually constitutes noise on a community level. The Day-Night Average Sound Level (Ldn) scale is a sound measurement technology that was developed to measure cumulative noise exposure in the community over the twenty-four hour day (Leq) (9). The Environmental Protection Agency recommends outdoor Ldn noise levels of 55 dB or lower and indoor levels of 45 dB or lowers in residential areas with outdoor space, rural areas, and hospitals. Table 8 details the recommended noise standards for specified types of land use.

Table 8
Land Use Compatibility with Yearly Day-Night Average Sound Levels

Land Use	Yearly Day-Night Average Sound Level (Ldn) in Decibels					
	Below 65	65-70	70-75	75-80	80-85	Over 85
Residential						
Residential, other than mobile homes and transient lodging.	Y	N(1)	N(1)	N	N	N
Mobile Homes	Y	N	N	N	N	N
Transient Lodging	Y	N(1)	N(1)	N(1)	N	N
Public						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals, Nursing Homes	Y	25	30	N	N	N
Churches, Auditoriums, Concert Halls	Y	25	30	N	N	N
Government Services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
Commercial						
Offices	Y	Y	25	30	N	N
Wholesale and Retail- building materials, hardware, etc.	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail- General	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
Manufacturing						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and extraction	Y	Y	Y	Y	Y	Y
Recreational						
Outdoor sport areas or arenas	Y	Y(5)	Y(5)	N	N	N
Outdoor amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusement parks, resorts, and camps	Y	Y	Y	N	N	N
Golf courses, riding stables, and water recreation	Y	Y	25	30	N	N

Key

Y = Land use and related structures compatible without restrictions. N = Land use and related structures NOT compatible and should be prohibited.

12, 30, or 35 = Land use and related structures generally compatible ; measures to achieve Noise Level Reduction (NLR) of 25, 30, or 35 dB must be incorporated into design and construction of structures.

Notes for Table

1. *Where the community determines that residential or school uses must be allowed, measures to achieve outdoor to indoor NLR of at least 25 and 30 dB into building codes and be considered in individual approvals. Normal residential construction can be expeted to provide an NLR of 20 dB; thus the reduction requirements area often stated as 5, 10, or 15 dB over standard construction.*
2. *Measures to achieve NLR 25 dB must be incorporated into the design and construction of portions of those buildings where the public is received, office areas, noise sensitive areas, or where the norma;l noise level is low.*
3. *Measures to achieve NLR 30 dB must be incorporated into the design and construction of portions of those vuildings where the public is received, office areas, noise sensitive ares, or where the normal noise level is low.*
4. *Measures to achieve NLR 35 dB must be incorporated into the design and construction of portions of those vuildings where the public is received, office areas, noise sensitive ares, or where the normal noise level is low.*
5. *Land use compatible provided special sound reinforcement systems are installed.*
6. *Residential buildings require an NLR of 25.*
7. *Residential buildings require an NLR of 30.*

EFFECTS OF NOISE

- Noise induced hearing loss is probably the best defined of the potential effects of human exposure to excessive noise. Federal workplace standards for protection from hearing loss allow for a time average of 90 dB over an 8-hour work period, or 85 dB averaged over a 16-hour period. Even the most protective criterion (no measurable hearing loss for the most sensitive portion of the population at the ear's most sensitive frequency, 4000 hertz (Hz), after a 40 year exposure) suggests a time average sound level of 70 dB over a 24-hour period. Since it is unlikely that persons will be exposed to elevated noise levels 24 hours per day for extended periods of time, there is little possibility of hearing loss below an Ldn of 75 dB (conservative level).

- Non-auditory health effects of long-term noise exposure, where noise may act as a risk factor, have never been found to occur at levels below those protective against noise induced hearing loss as described above. Most studies attempting to clarify such health effects have found that noise exposure levels established for hearing protection will also protect against any potential non-auditory health effects, at least in workplace conditions.

- Speech interference associated with noise is a primary cause of annoyance to individuals. The disruption of routine activities such as radio or television listening, telephone use, or family conversation gives rise to frustration and irritation. The quality of speech communication is also important in classrooms, offices, and industrial settings, and can cause fatigue and vocal strain in those who attempt to communicate over the noise. It has been shown that an exposure level exceeding 65dB will begin to interfere with speech.

- Sleep interference may be measured in either of two ways. "Arousal" represents actual awakening from sleep, while a change in "sleep stage" represents a shift from one of four sleep stages to another stage of lighter sleep without actual awakening. In general, arousal requires a somewhat higher noise level than does a change in sleep stage. The Environmental Protection Agency has identified an indoor Ldn of 45 dB as necessary to protect against sleep interference. Assuming conservative structural noise insulation of 20 dB for typical dwelling units, this corresponds with an outdoor Ldn of 65 dB as minimizing sleep interference.

- There are many scientific studies available regarding the effects of noise on wildlife but few of these studies include any reliable measures of the actual noise levels involved. However, in the absence of definitive data of the effect of noise on animals, the Committee on Hearing, Bioacoustics, and Biomechanics of the National Research Council have proposed that protective noise criteria for animals be taken to be the same as for humans.

NOISE MITIGATION METHODS

The major sources of noise in the City are from roadways, aircraft, and the railroad. Several methods can be employed to protect the public from these noises and their effects. Guiding the location of noisy activities can be accomplished through the zoning process. Other noise problems can be ameliorated by construction and design measures. Open space buffers, berm and barrier construction; placement of non-sensitive uses to buffer sensitive uses; and proper building orientation, lay out and construction are a few methods that can be used to minimize noise effects. Furthermore, evaluation of potential noise conflicts with new or expanded transportation facilities, such as airports and roadways, can incorporate noise mitigation measures in the design. Prohibiting nuisance noise as found in Chapter 9.16 in the City Code is effective and could be more effective with maximum decibel levels mandated with consistent enforcement.

ISSUES

Noise is a problem with many direct and indirect effects on the quality of life of residents. In addition to annoyance, other concerns about exposure to noise include the potential for hearing loss, other non-auditory health effects, the potential for speech and sleep interference, and possible effects on domestic animals and wildlife. Therefore, it is an issue of great importance to the safety and well being of the community.

GOAL, OBJECTIVES, POLICIES AND PROGRAMS

Goal: The City should participate in the protection of the environmental quality of the Las Vegas valley and to promote the conservation of our natural resources.

Objective 6A. The City should prohibit unacceptable community noise levels.

Policy 6A1: The City should implement a mandate that exterior noise levels of 55 Ldn and interior noise levels of 45 Ldn as the noise limits for residential, public and quasi-public uses in the City of Las Vegas.

Program 6A1.1: Utilizing the technical expertise of and in cooperation with state and local agencies, noise contours should be mapped throughout the City, particularly the areas adjacent to freeway routes, expressways, rail lines, North Las Vegas Airport, and McCarran International Airport.

Program 6A1.2: Planning and Development should begin the review of City Code pertaining to Noise and assess effectiveness of enforcement and abatement. Recommend revision where necessary.

Program 6A1.3: Through amendment of the City of Las Vegas Zoning Code, Planning and Development should require that development plans document noise conditions on the site and describe how excessive noise will be handled where "noise sensitive uses" are planned within 300 feet of a freeway, expressway, or rail line; within the approach or departure pattern for the North Las Vegas Airport; or adjacent to major thoroughfares.

Program 6A1.4: Based on the information in Table 8 and other resources, Planning and Development should locate non-noise sensitive uses with other non-noise sensitive uses and noise generators through the new Land Use Plan of the 2020 General Plan and associated zoning districts.

Program 6A1.5: Planning and Development should promote the inclusion in current development standards, and revisions of applicable section of the City Code such as building standards, provisions for noise attenuation in building design and construction.

Policy 6A2: The City should encourage cooperation with federal, state and local regulatory agencies in efforts to minimize noise impacts from all modes of transportation.

Program 6A2.1: The City should support the use of landscaping and sound walls as means to buffer transportation corridors.

Program 6A2.2: The Department of Public Works and other applicable / interested agencies and departments should participate in interagency project coordination committees in the review of transportation systems and corridors.

Program 6A2.3: The Department of Public Works and other applicable / interested agencies and departments should support the use of transportation technologies that minimize vehicular noise along freeways and near airports.

Program 6A2.4: The City should support the development and implementation of mass transit systems as alternatives to the freeways leading to the downtown.

EVALUATIONS AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific programs, and
- tool for further developing work programs.

The following abbreviations apply to each Evaluation and Implementation Matrix

City

BS	Building and Safety
CM	City Manager
PD	Planning and Development
LVMPD	Las Vegas Metropolitan Police Department

Table 9
Evaluation and Implementation Matrix : Noise

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
6A1	Mandate that exterior noise levels of 55 Ldn and interior noise levels of 45 Ldn as the noise limits for residential, public and quasi-public uses in the City of Las Vegas.	CM	2002	Amend City code.	
6A1.1	In cooperation with state and local agencies, map noise contours throughout the City, particularly the areas adjacent to freeway routes, expressways, rail lines, and the North Las Vegas Airport.	PD	2002	Noise Contour map on GIS	
6A1.3	Require that development plans document noise conditions on the site and describe how excessive noise will be handled where noise sensitive uses are planned within 300 feet of a freeway, expressway, or rail line; within the approach or departure pattern of the North Las Vegas Airport; or adjacent to major thoroughfares.	PD	2002	Develop guidelines for urban design techniques that abate noise.	
6A1.4	Locate non-noise sensitive uses near noise generators through the Land Use Plan of the General Plan and associated zoning districts.	PD	2001	Land Use plan of the 2020 General Plan and use reviews.	
6A1.5	Include in the City Code provisions for noise attenuation in building design and construction.	PD, BS	2001	Amend code.	
6A2	Cooperate with federal, state and local regulatory agencies in efforts to minimize noise impacts from all modes of transportation.	CM	Ongoing		

TRANSPORTATION

The purpose of this section of the Public Safety Plan is to explain how the services of those City agencies responsible for transportation issues will accomplish the goals of public safety in a comprehensive manner. Discussion will detail how those agencies will abide by the general policies of the Las Vegas 2020 Master Plan.

Scene of smooth traffic flow is an increasingly rare sight in the valley with the overwhelming volume of vehicles on the valley roadways as the valley population grows

INTRODUCTION

A safe, efficient ground transportation system is essential to public safety. Street and highway design affects conditions in which we live and the safe operation of motor vehicles. The safe transport of hazardous materials, efficient provision of fire and police protection paramedic services, public utilities and refuse collection, and the movement of the general public all depend on an adequate transportation system that incorporates all modes of transportation. As the only major ground transportation system in the Las Vegas metropolitan area, streets and highways must allow for safe and efficient movement of people and materials by day and night in all weather conditions.

The City of Las Vegas is dedicated to the safe and efficient movement of people and goods within the community. Safety, as an overriding concern in all transportation projects, and to those who use them, is emphasized in the following issues and solutions.

PEDESTRIAN SAFETY

Each year, thousands of Americans are killed and tens of thousands are injured walking down the nation's streets. In 1997 and 1998, 10,696 pedestrians in the U.S. were killed in traffic accidents (5,406 in 1997 and 5,291 in 1998). More than 1,500 of these victims were children under the age of eighteen.

Walking is far more dangerous per mile traveled than the more common modes of travel, flying or driving. The fatality rate per 100 million miles traveled was 1.4 deaths among automobile drivers, and .16 deaths among people who fly. But 50 pedestrians died for very 100 million miles walked in 1997(12). This means that walking is 36 times more dangerous than driving, and over 300 times more dangerous than flying.

Studies have shown that walking tends to be more dangerous in newer areas of the nation's west and southwest regions. Most of these areas have been built up since the 1950's and are dominated by subdivisions, office parks, and high-speed roads that are designed for the fast and efficient movements of vehicles. This means that pedestrians may be forced to walk alongside high speed roads without any sidewalks (such as along Charleston near I-515), and often must contend with crossing wide, busy streets with no medians and few safe crossing points. Intersections are often designed with wide, sweeping curves that allow vehicles to keep moving at a high speed, but increase the crossing distance and danger for pedestrians. Traditional commercial site design have businesses separated from the streets by large expanses of parking lot asphalt, forcing pedestrians to thread their way through a maze of parked and moving vehicles in order to reach their destinations. In such sprawling environments, the combination of wide roads with high speed traffic and vehicle oriented environments without pedestrian facilities can be deadly.

One example of pedestrian unfriendly streetscapes, as shown in this photo taken along Bonanza Road

Traditionally, painted crosswalks and walk signals have been thought of as the solution to the conflicts between vehicles and pedestrians. But these do little to improve pedestrian safety when used in a haphazard fashion. Current thinking forces pedestrians to walk long distances to the crossings instead of organized in a manner that would enable the crossings to help instead of hinder pedestrian movement. Such thinking is a byproduct of the attitudes toward traffic safety in the minds of many traffic engineers. They see their top priority as making roads safer to drive at higher and higher speeds, with little consideration of the effect this might have on those not driving.

Who is at risk because of the current focus vehicle movement? In 1997 to 1998, sixteen percent of pedestrian deaths were people under 18 years old. Twenty two percent of all pedestrians killed were over the age of 65, even though only 13 percent of the population is elderly. Many pedestrian facilities, particularly walk signals, are timed for use by young adults in good health, not for smaller children or the elderly who may not be able to walk fast enough to cross safely.

Much of the decline of walking as a means of travel can be attributed to the increase in neighborhoods designed so that it is not safe or convenient to travel by foot. Residential areas with no sidewalks (or sidewalks up against the curb with only enough width to keep street lights, utility boxes, or fire hydrants out of the street) and wide streets have been built only with high- speed car

travel in mind. The nearest store, school, or workplace is often far beyond the quarter to half a mile radius that is most convenient for foot travel. Workplaces are often located in office parks accessible only by car, and isolated from any other supporting services.

There is ample evidence that compact, walkable communities that mix housing, workplaces, and shopping are places where people take more trips on foot (13). But such traditional neighborhoods are often only found in city centers or older parts of town. One recent study of Seattle neighborhoods found that the newer the development, the less likely it is that residents will walk, bicycle, or take transit.

In addition to the shift back to mixed, walkable environments, many communities across the country are making streets safer with traffic calming techniques. Traffic calming redesigns streets to reduce vehicle speeds and give more space and priority to cyclists and pedestrians. Traffic calming includes a variety of changes that slow or divert vehicle traffic, separate pedestrian pathways from traffic, and make road corridors more pleasant. One study found that traffic calming reduced speeds by four to twelve miles per hour. Officials in Seattle estimate that their traffic circle program prevented 273 accidents over four years, saving $1.7 billion in property and casualty losses (14).

The inclusion of landscaping buffers enhances the visual quality of local streetscapes

It is more than likely that pedestrian safety, and the environs that influence pedestrian safety, will continue to be of greater and greater importance to citizens of the valley. Transportation funds will need to be shifted from traditional projects to be devoted to projects of greater pedestrian emphasis. With so many streets designed only for vehicles, it will take more than a few sidewalks and crosswalks to make them safe and inviting for pedestrians. Use of traffic calming techniques will slow down vehicles in key places and reclaim the streets for children, residents, and others on foot or bicycle.

New neighborhoods, and the streets that serve them, will need to be designed with the goal in mind of emphasizing the walk-ability of the neighborhood. More people will walk in those neighborhoods where there is somewhere to go by foot and the means to get there. Those neighborhoods designed for pedestrians will locate residents within a reasonable distance of shops, offices, schools, and transit stops, and provide a street and path network that allows direct routes between them.

ISSUES

Pedestrian Safety

The current design of residential areas and commercial sites emphasizes the access and mobility of vehicles to the detriment of public safety. Site design methods and development philosophy need to shift back to the thinking of before the automobile became the deciding factor of where the public lives, works, and plays. Areas and whole communities can be designed so that the automobile does not have to be the only method by which the public can circulate from home, activity, or work. Such a shift in thinking will substantially reduce the number of needless deaths and injuries due to the incompatibility of today's streets and the walking public.

Beltway construction at Summerlin Parkway

Bridgework over US 95 at the major intersections was started in 2000, shown is the now open overpass at Centennial Parkway in the northwest area

GOAL, OBJECTIVES, POLICIES, AND PROGRAMS

Goal: The City should promote the safe and efficient transport of people and materials as well as a system that can meet the demands of other public safety and health services.

Objective 7A. The City should provide for a safe traveling environment.

Policy 7A1: The City should promote safe use of City streets by supporting programs that encourage vehicle maintenance, use of seat belts and helmets, and discourage the use of impairment inducing substances.

Program 7A1.1: The City should support public information programs that encourage motorcycle and bicycle riders to wear helmets whenever they ride.

Program 7A1.2: The City should support public awareness programs that encourage bicycle and pedestrian safety, such as school safety programs that emphasize pedestrian, bicycle, and traffic safety.

Policy 7A2: The City should encourage the monitoring of the effectiveness of procedures, guidelines, and codes in terms of transportation safety.

Program 7A2.1: The City should support enforcement efforts that should encourage all pedestrians, cyclists, and drivers of motor vehicles to obey traffic signs and signals, and follow the rules of the road.

Program 7A2.2: The City should encourage a survey of school zones for proper compliance to standards.

Program 7A2.3: Public Works should continue the careful review of new development to assure compliance with accepted design standards for proper sight distance at intersections.

Program 7A2.4: Public Works should implement a survey of existing development for compliance with accepted design standards for proper sight distance at intersections, and the establishment of policy to help enforce compliance.

Program 7A2.5: Public Works should implement a periodic review of speed limits to assure that they reflect speeds that are safe and proper for existing conditions.

Program 7A2.6: The City should develop and implement such policy that will require the use pedestrian friendly urban design methods such as mixed use developments.

Program 7A2.7: The City should incorporate traffic calming designs as part of street design to encourage walking as a method of transportation.

EVALUATIONS AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific programs, and
- tool for further developing work programs.

The following abbreviations apply to each Evaluation and Implementation Matrix

City

PD Planning and Development
PW Public Works

Other Agencies / Jurisdictions

CCSD Clark County School District

Table 10
Evaluation and Implementation Matrix :Transportation

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
7A2.2	School zones should be surveyed for proper compliance to standards.	CCSD	2002	Survey	
7A2.3	New development should be carefully review to assure compliance of sight distance requirements at intersections.	PW	Ongoing		
7A2.4	Existing development should be surveyed for compliance of sight distance standards.	PW	2002	Survey	
7A2.4	Prepare policy to enforce compliance of sight distance standards.	PD, PW	2002	Amend Code	
7A2.5	Speed limits should be reviewed periodically to assure that they reflect speeds that are safe and proper for existing conditions.	PW, LVMPD	2002		

HAZARDOUS MATERIALS

The purpose of this section of the Public Safety Plan is to explain how the services of the City Las Vegas will be incorporated in the accomplishment of public safety in a comprehensive manner as it relates to hazardous materials, particularly high level nuclear waste. Discussion will detail how the City of Las Vegas should coordinate with other agencies on maters concerning hazardous materials per Policy 7.3.2 and 7.3.8 of the 2020 Master Plan.

INTRODUCTION

Hazardous materials are a part of modern life. When properly managed, their potential to harm people and the environment can be minimized. This is done through limiting and regulating the transportation, distribution, storage, use, and disposal of hazardous materials within the community.

The citizens also have a responsibility in the management of hazardous materials. Used motor oil and many common household cleaning and pest control products can negatively impact the environment when they are dumped on the soil or put into landfills. Disposal of hazardous materials is an individual responsibility and collection of hazardous house wastes can be coordinated with the local bulk waste disposal management company. Recycling or disposal of such materials helps reduce groundwater contamination.

The term "hazardous materials" encompasses a large number of substances, including toxic metals, chemicals, and gases; flammable and / or explosive liquids, solids, and gases; erosive materials; infectious substances; and radioactive materials. The transport, distribution, storage, use, and disposal of materials are of extreme concern of the community. There is a potential for catastrophe as well as the pollution of the environment. Of general concern to the Las Vegas valley, and the City of Las Vegas in particular, is the potential of transportation of radioactive waste through the City to the proposed repository at Yucca Mountain, not to mention the potential to impact communities across the nation.

THE RADIOACTIVE WASTE ISSUE: THE CITY'S POSITION

In light of issues such as

- Yucca Mountain is the preferred high-level nuclear waste repository site,
- the waste that will be stored at the repository is potentially extremely dangerous, and
- accidents are possible while the waste is in transit,

the City of Las Vegas has been compelled make it's position clear about the transport of radioactive waste through the City.

On September 6, 2000 the Mayor and City Council of the city of Las Vegas adopted a resolution (R-85-2000) that opposes all legislation that would require or allow the transportation of radioactive waste near or through the City. By the resolution, the City maintains that such waste should be stored at the sites where the waste is generated and the funding that is focused on Nevada as being the only storage option should be shifted to the task of finding a scientifically defensible and publicly acceptable method of disposal. Through the resolution, the Mayor and Council, because of their opposition of legislation that would allow the transportation, storage, or production of high-level nuclear waste, has designated the City of Las Vegas as a Nuclear Free Zone.

Bristlecone Pine Rainier Mesa and Stockade Wash (U.S. Department of Energy photograph).

It is because of the concerns of the City about this issue, particularly that billions of tax-payer dollars have been spent on the Yucca Mountain Repository project and legislation is being introduced each year that will allow the transport of radioactive waste through the City and may be signed into law ay any time, that this section has been prepared. This section will review the facts about how highly radioactive waste is generated, the plans for transporting the waste, and how the waste is to be stored. If Yucca Mountain is selected as the repository of high level nuclear waste this section will also provide long-term policy, objectives, and programs for the City's role in this sensitive issue.

IMPACTS OF NUCLEAR WASTE TRANSPORT

Studies by the State of Nevada (10) and the Department of Energy (DOE) indicate that 43 states would be directly impacted by thousands of spent nuclear fuel and high-level radioactive wastes shipments to Yucca Mountain. At least 109 cities with populations over 100,000 plus thousands of smaller communities could be affected by such shipments.

The many uncertainties surrounding the transportation of nuclear waste to a repository make it extremely difficult to assess potential impacts and plan for contingencies. DOE and the nuclear industry point to the past history of spent nuclear fuel shipments as an indication of the inherent safety of this type of transport activity. While it is true that, since 1962, there have been no radioactive releases as a result of transportation accidents, the amount of waste shipped to a repository in the first full year of operations alone will exceed the total amount shipped in the United States for the past 30 years. In addition, the distances over which spent nuclear fuel and high-level radioactive wastes would have to be shipped will be much greater for future repository shipments than for past shipments. Past shipments of nuclear waste have often been shorter-distance transfers of spent nuclear fuel from one utility location to another.

The State of Nevada has been examining transportation issues associated with the proposed repository for over 10 years. As a result of the State's work, a number of unresolved safety issues have been identified. These will be discussed in detail in the following pages.

ISSUES ON NUCLEAR WASTE

1. *Transportation Feasibility and Risks*
   The way in which waste is shipped is an area of doubling uncertainty. DOE believes it would be safer to ship waste by rail, since rail shipments could be larger, carry more waste and ultimately require fewer numbers of shipments. However, a number of reactor sites, where waste is currently generated, do not have rail access or are not capable of handling large rail casks.

   To date, DOE has identified three potential rail spur routes in Nevada. Detailed analysis has been performed on only one, and DOE has no plans to study the others in more detail anytime in the near future. The route DOE has studied would require the construction of 360 miles of new track from the Union Pacific main line near Caliente, NV along a roundabout route to Yucca Mountain. The cost would be between $1 billion and $1.4 billion (in 1990 dollars). DOE's own analysis indicates there would be significant engineering challenges and, because of environmental hurdles involved with this spur construction, would have to undergo detailed and lengthy environmental reviews under the National Environmental Policy Act (NEPA).

All of the other possible rail spur options identified by DOE have similar problems, and it is questionable whether rail access can be provided - or whether Congress will appropriate the funds needed for an exceedingly expensive and potentially controversial rail line when highway access is presently available.

Legislation currently before Congress would require DOE to use an intermodal system of spent nuclear fuel and high-level radioactive wastes transportation to Yucca Mountain or an interim storage site. This would entail the shipment of wastes in large containers by rail to eastern Nevada, and then transferring the canisters to very large "heavy haul" trucks for the trip to Yucca Mountain. Such transport poses new problems, including interference with routine traffic on existing state and U.S. highways, possible weather related problems and risks for large heavy haul vehicles in the winter months, added risks associated with extra handling and long distance truck transport, susceptibility to terrorist attack, and other problems.

2. *Highway Transport Risks*
Without rail access to Yucca Mountain or some form of intermodal transfer system, all waste would have to be shipped by truck along the nation's interstate highways or alternative routes designated by states. This creates the possibility that between 35,000 and 100,000 shipments, during the 25-year emplacement phase of the proposed repository will be required through urbanized areas.

Workmen ready a crane to lift a shipping cask containing spent reactor fuel from a truck bed. The crane and other equipment is controlled remotely to remove the radioactive fuel from the cask (U.S. Department of Energy photograph)

Under present federal routing requirements for spent nuclear fuel and high-level radioactive wastes materials, most of these shipments would be routed through heavily populated areas of major U.S. cities. Under federal regulations, alternative routes could be designated by the states, but any alternative route designations would involve tradeoffs in terms of risk to population centers in contrast to those risks associated with the use of longer routes on two lane highways over difficult terrain and through rural communities. Actions by states to designate alternative routes are complicated by a recent court decision in New Mexico that could make state and local governments liable for loss of property values along designated shipping routes.

Truck shipments in the numbers needed for moving wastes to a repository from reactor sites around the nation would put nuclear waste trucks on the country's interstate highways in large

numbers year round for almost 3 decades. Because of the numbers of shipments involved, the chances for accidents will increase, and because the new casks will carry more waste per shipment, the consequences of a very severe accident could also increase.

3. *Radiological Effects of Routine Shipments*
One the areas of concern in nuclear waste transportation is the exposure of waste handlers, drivers, and the general public to radiation even during routine (non-accident) conditions. Even though shipping containers are shielded and designed to reduce exposures to radiation from spent nuclear fuel or high-level radioactive wastes, federal regulations allow a low level of radiation to emanate from the casks. This level is not dangerous under normal conditions. Nevertheless, repeated and long-term exposure to these low levels of radiation can have health consequences that need to be monitored and managed.

The radiation level of the material within the containers, even after ten years of cooling, spent nuclear fuel emits dangerous levels of gamma and neutron radiation. A person standing one yard away from an unshielded spent nuclear fuel assembly could receive a lethal dose of radiation (about 500 rems) in less than three minutes. A 30 second exposure (about 85 rems) at the same distance could significantly increase the risk of cancer and/or genetic damage. Defense high-level waste, which contains even higher concentrations of gamma-emitting fission products, is similarly dangerous. The surface dose rate of spent nuclear fuel is so great (10,000 rem/hour or more), that shipping containers with enough shielding to completely contain all emissions would be too heavy to transport economically. Federal regulations allow shipping casks to emit 10 millirems/hour at 2 meters from the cask surface. This is equivalent to about one chest x-ray per hour of exposure.

Routine exposures become especially problematic in situations where the transport vehicle is caught in heavy traffic with cars and other vehicles in close proximity for extended periods. Routine exposures also are of concern when the cask vehicle is stopped for repair, fueling, inspections, etc.

The health effects of even low-level radiation are poorly understood. There is evidence that even small amounts of radiation can have long-term health implications. The potential effects of repeated exposures to large numbers of nuclear waste shipments along highways or railroads during the 25-year repository emplacement phase have not been adequately addressed and could have adverse health consequences for certain segments of the public.

4. *Probability of Serious Accidents*

Between 1957 and 1964, there were 11 transportation incidents and accidents involving spent nuclear fuel shipments by the US Atomic Energy Commission and its contractors. Several of these incidents resulted in radioactive releases requiring cleanup, including leakage from a rail cask in 1960 and leakage from a truck cask in 1962. There is no comparable data for the period from 1964 to 1970, when utility shipments to reprocessing facilities began. Between 1971 and 1990, there were six accidents and 47 incidents involving nuclear waste shipments. Three accidents (two truck, one rail) involved casks loaded with spent nuclear fuel. No radioactivity was released in these accidents. Most of the incidents involved excess radioactive contamination on cask surfaces, a result of the so-called "weeping" phenomena on casks loaded and unloaded in wet storage pools.

Based on the 1971-1990 accident data, DOE calculated accident and incident rates for commercial spent nuclear fuel shipments to a repository. For truck shipments, DOE calculated 0.7 accidents and 10.5 incidents per million shipment miles. For rail shipments, DOE calculated 9.7 accidents and 19.4 incidents per million shipment miles. Although the number of spent nuclear fuel shipments and accidents during these years was small, DOE compared these accident/incident rates to the general accident rates for large commercial truck and freight rail movements. The DOE concluded the general rates should be used in repository transportation risk and impact studies. DOE recommended use of a truck accident rate of 0.7 - 3.0 accidents per million shipment miles and a rail accident rate of 11.9 accidents per million shipment miles.

An estimate of the number of accidents likely to occur during spent nuclear fuel shipments to a repository can be obtained by multiplying the anticipated accident rates by the anticipated cumulative shipment miles. If all spent nuclear fuel were to be shipped to the repository by truck in larger-capacity casks, requiring about 46,000 shipments and over 100 million shipment miles, between 70 and 310 accidents and over 1,000 incidents would be expected over the operating life of the repository. Under the DOE base case scenario (88% rail, 12% truck), about 50 to 260 accidents and 250 to 590 incidents would be expected.

While accidents severe enough to cause a failure of the transport cask, with a resulting release of radioactive material, are likely to be rare, the potential exists for serious accidents to occur. Transport containers for repository bound waste shipments have not yet been designed or built. Although Nevada and other states have been advocating it for ten years, DOE has not committed to full scale testing of the casks.

Both DOE and State of Nevada researchers have looked at the potential for a worst-case accident to occur. While there is disagreement over the specifics of a credible worst-case scenario, there is agreement that such an accident would involve the release of some of the radioactive material inside the shipping cask.

Spent nuclear fuel is both highly radioactive and thermally hot. Nuclear fission inside a reactor transforms a small percentage of the original uranium fuel into additional uranium isotopes, isotopes of plutonium and other transuranic elements, and fission products such as strontium-90 and cesium-137. Fission products, which account for most of the radioactivity in spent nuclear fuel during the first hundred years after removal from a reactor, emit both beta and gamma radiation. Reactor operations may also coat the exterior of the fuel rods with corrosion products, or "crud", containing radioactive isotopes of cobalt, nickel, and iron.

View of Alcove 8 test bed prior to instrumentation (U.S. Department of Energy photograph).

A typical ten-year old spent nuclear fuel assembly from a Pressurized Water Reactor (PWR) contains about 26,000 curies of strontium-90 (plus many thousands of curies of other dangerous isotopes). The strontium-90 in just one spent PWR assembly would be sufficient to contaminate twice the volume of water in Lake Mead (23 trillion gallons). While the strontium -90 and most of the other dangerous radionuclides are part of the solid pellets that make up the fuel, and therefore not easily dispersed, a severe accident or series of human errors could cause a release of fuel and/or crud particles mixed with smoke accompanying a fire. The airborne particles could then be inhaled or enter the soil and contaminate the food chain. There are other related isotopes that remain highly radioactive for decades are so hazardous that inhalation or ingestion of even amounts too small to be seen can lead to cancer, radiation-induced disease, and death.

A 1985 DOE contractor report concluded that a severe accident involving a single, current-generation rail cask could result in release of radioactive materials to the environment. The study assumed a severe impact followed by a massive fire fed by large quantities of fuel. According to the study, release of only a small fraction (1380 curies) of the cask's contents would be sufficient to contaminate a 42 square mile area. The costs of cleanup after such an accident would exceed $620 million, and the cleanup effort would require 460 days, if it occurred in a rural area. An alternative analysis by a DOE contractor estimated cleanup costs for the same rural accident ranging

from $176 million to $19.4 billion, depending primarily upon post-accident soil concentrations of cobalt-60, cesium-134, and cesium-137, and upon regulatory requirements for disposal of the contaminated soil.

If a similar accident occurred in a typical urban area, the clean up would be considerably more expensive and time consuming. It is estimated that it would cost $9.5 billion just to raze and rebuild the most heavily contaminated square mile or so. Much more detailed studies are necessary to estimate accident cleanup costs for a specific urban location such as metropolitan Las Vegas.

The conditions under which a worst-case accident could occur are poorly understood. DOE places great faith in the design and performance of the shipping container to prevent such an occurrence. However, without full-scale testing, shipping cask performance is, of itself, an area of significant uncertainty. Moreover, new shipping cask designs create new opportunities for human error. The longer shipping distances required because of Yucca Mountain's location (more than 2,200 miles on average compare to 600 miles for past shipments) would create additional opportunities for equipment failures and human errors.

Solid low-level wastes generated by weapons production are packaged, transported, and buried without changing the package integrity (U.S. Department of Energy photograph).

5. Shipping Cask Performance

The first line of defense against an accident involving the release of radioactive material is, in DOE's planning for repository shipments, the shipping container. Designed to be extremely rugged and to withstand severe accident conditions, these casks are intended to assure adequate containment of spent nuclear fuel and nuclear wastes as these are transported from the reactor to a repository. DOE and the nuclear industry point to a good (although not flawless) record of shipping spent nuclear fuel since 1964 as evidence that casks will perform as they are intended.

The State of Nevada's concerns regarding cask performance involve questions about the cask's ability to withstand severe accidents under projected shipment volume conditions, the adequacy of testing requirements, and implications of new cask designs.

While shipping casks are required to be licensed by the U.S. Nuclear Regulatory Commission (NRC), there is no requirement for the actual testing of full-scale casks to determine how they perform. A scaled down cask is required by NRC to be able to withstand, in succession, the following four tests: a drop from 30 feet onto an unyielding surface; a drop from 6 feet onto a spike (a puncture test); a 30 minute fire at 1425 degrees (F); and then a 30 minute submersion in three feet of water. The

NRC allows cask designers to substitute scale-model (1/10 to _ scale) tests and computer simulations for full-scale design testing. Moreover, the NRC performance standards are based on hypothetical accident scenarios supported mainly by a technical study known as the Modal Study, prepared by Lawrence Livermore National Laboratory. The Modal Study's transportation assumptions are not relevant to DOE's Yucca Mountain transportation plans. Additionally, detailed case studies of recent truck and rail accidents have raised serious doubts about how well the NRC standards reflect real world accident conditions. This is particularly the issue regarding accidents involving high-speed impacts (over 55 miles per hour), long duration of accident conditions (up to several days) and high temperature (over 2000 degrees F) fires, and collisions with vehicles carrying high-energy explosives.

Acoustic Temography test activities in Alcove 8 (U.S. Department of Energy photograph).

None of the spent nuclear fuel casks currently in use have been tested full-scale. The spectacular crash and burn films shown by DOE and the nuclear industry actually depict obsolete casks (withdrawn from service) being tested in the 1970's to validate computer models. Those tests were successful for that purpose, and also provided valuable insights into the importance of cask tie-down systems and other issues. The tests also demonstrated the vulnerability of lead gamma shielding to long duration fires and to multiple impacts. However, the tests were not intended to simulate worst-case accidents or to prove the overall safety of spent nuclear fuel shipments.

The casks that might be used in a repository shipping campaign are currently being designed. None of the designs have yet been licensed or fabricated. Due to the planned increase of cask size, such casks are very likely to be markedly different from current casks. All of the new designs proposed by DOE would hold more fuel assemblies and be less heavily shielded (due to the age of the fuel to be shipped and weight considerations). How these casks will perform in real world accident situations is uncertain.

The new, larger transportation casks (100-125 tons each) being considered for future spent nuclear fuel shipments have the potential, if not properly loaded, to allow the fuel assemblies to go critical under certain conditions - i.e., start a nuclear chain reaction that would cause a catastrophic temperature rise in the canister. The imperative for accurate and verified fuel loading calculations increases the potential for human error and thereby increases the risks and uncertainties associated with waste transport.

The use of such larger shipping containers raises questions about the adequacy of current NRC cask licensing regulations and about the appropriateness of these regulations for assuring these new and much larger canisters will be able to withstand real world accident conditions.

The State of Nevada, the Western Interstate Energy Board, the Western Governors' Association, and numerous other states and multi-state organizations have made detailed recommendations to DOE for full-scale cask testing to demonstrate compliance with the current NRC performance standards, reexamination of the adequacy of the NRC standards, and possible extra-regulatory testing to determine cask failure thresholds. To date, DOE has ignored these recommendations and has no plans to test proposed new cask designs.

Steel cargo containers of solid transuranic waste are being stacked for above ground storage at the Nevada Test Site Area 5 Radioactive Waste Management Site. Each container holds up to 50 drums of transuranic waste (U.S. Department of Energy photograph).

6. Waste Type and Volume

The issue of how much and what type of wastes would be shipped to a repository remain unclear. The first repository is currently limited by law to be no more than 70,000 metric tons of uranium (MTU). However, given the expected amount of spent nuclear fuel from currently operating reactors and defense high-level waste requiring disposal in a repository, more than 100,000 MTU of high-level radioactive wastes could be earmarked for the proposed Yucca Mountain repository. Additionally, an unknown amount of miscellaneous wastes could also be shipped to Yucca Mountain.

The volume and types of waste make a great deal of difference in terms of transportation operations and transportation risks. If all waste available for disposal in a repository is shipped to Yucca Mountain, the number of shipments increases significantly. Civilian spent nuclear fuel from nuclear power plants will be the largest source of high-level radioactive waste shipped to the repository. Under current law, with capacity limited to 70,000 MTU, DOE has reserved 90% of the repository capacity, or about 63,000 MTU, for civilian spent nuclear fuel. However, the currently operating nuclear power plants are projected to generate between 80,000 MTU and 85,000 MTU of civilian spent nuclear fuel by the year 2030. Since there are presently no plans for constructing a second repository, the Agency's planning studies assume that DOE will attempt to ship all civilian spent nuclear fuel to Yucca Mountain if the site is licensed. DOE-owned spent nuclear fuel, from foreign and domestic research reactors and from nuclear-powered naval vessels, will likely also be shipped to Yucca Mountain. This has implications for increased accident risks and routine exposures, and the need for heightened emergency preparedness.

The total amount of defense high-level radioactive wastes requiring geologic disposal is unknown. DOE has allocated 7,000 MTU of capacity at the repository (about 14,000 canisters) for high-level defense wastes. This waste has been generated at DOE weapons facilities at Hanford, Washington, Idaho Falls, Idaho, and Savannah River, South Carolina. Most of this waste is presently stored in liquid form in underground tanks. Prior to shipment, these wastes would be solidified in borosilicate glass logs inside stainless steel canisters. The total amount of such high-level radioactive wastes requiring disposal in a repository has been estimated to be as high as 40,000 canisters, which is equivalent to 20,000 MTU of spent nuclear fuel. The shipping containers for these wastes have not been designed yet, but for planning purposes, DOE has assumed two canisters per truck cask and 5 canisters per rail cask. Shipment of 7,000 MTU of these high-level radioactive wastes would require 7,000 truckloads or 2,800 rail casks; shipment of 20,000 MTU would require 20,000 truckloads or 8,000 rail casks.

In addition to spent nuclear fuel and high-level radioactive wastes, a significant quantity of miscellaneous wastes will likely be shipped to a repository. These are transuranic wastes from commercial reactors and industrial facilities, radioactive cesium capsules used in commercial irradiation facilities, reactor decommissioning wastes, and wastes from routine nuclear power reactor operations which are too radioactive for disposal in low-level waste sites. No one knows for sure what will be the amount of these wastes or their transportation package capacities. In 1987, DOE estimated that these wastes could total between 12,100 and 20,600 cubic meters. Such an amount would be equivalent to between 12,100 and 20,600 canisters of defense high-level waste in volume.

This is a view looking southeast across an area where the Carlin rail corridor is proposed, one of five potential rail routes being consider by the U.S. Department of Energy (DOE) to support site investigation activities at the proposed High Level Waste Repository at Yucca Mountain, Nevada.

GOAL, OBJECTIVES, POLICIES, AND PROGRAMS

Goal: The City should protect the community from the risks inherent in the use, storage, transportation, and handling of hazardous materials, recognizing that the use of such substances is an integral part of our society and economy.

Objective 8A. The City should require the safe storage, transportation, and disposal of hazardous materials.

Policy 8A1: The City should cooperate with other government agencies in the development of standards for the proper storage, transportation, and disposal of hazardous materials.

Program 8A1.1: In collaboration with Clark County and the State of Nevada, the City should identify highways and railroads near and within the city that are being or can be used to transport hazardous materials.

Program 8A1.2: Fire and Rescue, along with Clark County and the State of Nevada should continue the process of determining how a transportation incident could affect the city.

Policy 8A2: The City should support State and Federal legislation that strengthens safety requirements for the transportation of hazardous materials.

Program 8A2.1: The City should continue the adoption of new or revision of existing codes and ordinances that strengthen hazardous materials transportation requirements.

Program 8A2.2: The City should encourage interagency cooperation and communication that should strengthen local hazardous materials transportation requirements.

Policy 8A3: Fire and Rescue should continue the preparation of strategies and plans for the evacuation of inhabitants and for the handling of emergencies involving hazardous materials.

Program 8A3.1: The City should encourage the establishment of procedures to notify emergency management and response organizations of an incident.

Program 8A3.2: The City should encourage the establishment of procedures to warn the public of an incident.

EVALUATION AND IMPLEMENTATION MATRIX

The following Evaluation and Implementation Matrix (EIM-see next page) was prepared as a measurable summary of the above Policies and Programs. The EIM is to be used as a:

- method of measuring the implementation progress of the Plan,
- budgeting document for specific programs, and
- tool for further developing work programs.

The following abbreviations apply to each Evaluation and Implementation Matrix

City

PD	Planning and Development
PW	Public Works
FR	Fire and Rescue

Table 11
Evaluation and Implementation Matrix : Hazardous Materials

Policy / Program	Summary	Department	Implementation	Action / Product (Related Program)	Remarks
8A1	Cooperate with other government agencies in the development of standards for the proper storage, transportation, and disposal of hazardous materials.	FR	Ongoing		
8A2	Support State and Federal legislation that strengthens safety requirements for the transportation of hazardous materials.	PW, FR			
8A3	Prepare strategies and plans for the evacuation of inhabitants and for the handling of emergencies involving hazardous materials.	FR	Ongoing		

DEFINITIONS

Apparatus- A motor driven fire truck, or a collective group of such trucks, which may be different types such as pumper trucks, ladder trucks, etc. (11)

Automatic Aid- A form of mutual aid involving a pre-arrangement between two or more departments that routinely provides emergency response assignments to each other.

Badlands- Badlands area moderately steep to very steep barren dissected by many intermittent drainage channels that have cut into soft geological material. The areas ordinarily are not stony. Local relief generally ranges form 25 to 100 feet. Potential runoff is very high, and erosion is active. Some small-included areas of identifiable soils support vegetation.

Characteristic- An attribute, descriptive feature, or identity.

Community- A commonly located, interacting population people and business.

Compaction Faults- Shifts in the ground surface due to natural prehistoric dewatering and differential consolidation of sediments.

Data- Raw facts or observations; factual material used as a basis especially for discussion or decision: information.

Endogenic Subsidence- Subsidence due to changes occurring within the earth, such as natural movement of the earth's tectonic plates, volcanic activity, and continental drift.

Evaluation- Measuring the success of a program or concept.

Exogenic Subsidence- Subsidence occurring mainly at the earth's surface due to loss of support, as in the case of fluid extraction, or an increase of loading from the weight of a body of water, such as Lake Mead, or heavy irrigation.

Fire Prevention- That part of fire protection activities exercised to prevent ignition of unwanted fires and to minimize loss when fire does occur.

Fire Protection- The science of reducing losses of life and property due to fire, including both prevention and extinguishment by public or private means. Also, the degree to which such protection is applied.

Fire Protection System- An organized arrangement of people and things performing defined functions to prevent or control unwanted fires.

Function- Something a system does, an activity.

Goal- The general end toward which an effort is directed. That which a system is intended to eventually accomplish.

Hardpan- A hardened or cemented soil horizon or layer. The soil material is sandy, loamy, or clayey and is cemented by iron oxide, silica, calcium carbonate, or other substances.

Mutual Aid- Two way assistance by fire departments of two or more communities freely given under prearranged plans or contracts on the basis that each will aid the other.

Noise- Any useless sound which annoys or disturbs humans or which causes or tends to cause an adverse psychological or physiological effect on humans.

Objective- Something specific toward which an effort is directed. A specific accomplishment necessary in order to achieve goals, the results of which can be measured.

Optimum- Most desirable thing, or status, greatest degree, etc. under implied or specified conditions. Not necessarily either a maximum or minimum.

Pits, Gravel- Consists of open excavations from which soil material and gravel have been removed, exposing rock, a hard pan, or other material.

Projected- Looking forward to the future; forecast in the basis of present information.

Repository- a place where things are stored for safekeeping.

Response- An act responding to an alarm.

Response Time- The length of time required by a complement of firefighters and equipment to respond to a reported fire or other emergency. Response time usually is measured from the time alarm is received by the fire units to the time of arrival at the fire or in the area of the fire.

Risk- Possibility of loss, as in "acceptable fire risk".

System - An arrangement of parts or elements (people, things, and / or organizations) working together to perform a set of operations in the accomplishment of the purpose of the whole, as in "heating system".

Tectonic Faults- Cracks in the earth, resulting from changes in the structure of the earth's crust.

Urban Land- Consists of areas covered by asphalt, concrete, and buildings or other urban structures.

REFERENCES

1 Clark County 208 Water Quality Management Plan Amendment, Clark County, Nevada, June 1990, p. 6-5.

2 Ibid. p. 5-13.

3 "Subsidence in Las Vegas, Pahrump, and Indian Springs Valley, Clark and Nye County", Nevada Department of Conservation and Natural Resources, Water Resources Bulletin 5.

4 Ibid. p. 5-16.

5 Clark County Comprehensive Plan, Clark County, Nevada, 1982, p. 17.

6 "Subsidence in Las Vegas Valley", John W. Bell, Nevada Bureau of Mines and Geology, Bulletin 95, 1981, p. 36.

7 Clark County Comprehensive Plan, Clark County, Nevada, 1982, p. 17.

8 "Subsidence in Las Vegas Valley", John W. Bell, Nevada Bureau of Mines and Geology, Bulletin 95, 1981, p. 10.

9. Renewal of the Nellis Air Force Range Land Withdrawal, Department of the Air Force, Draft Legislative EIS, Vol. 1, 1998, p. 4.2-1 through 4.2-11.

10. Transportation of Spent Nuclear Fuel and High Level Radioactive Waste to a Repository, State of Nevada Nuclear Waste Project Office, 1999, p. 1-13

11. Master Planning for Fire Protection, FEMA, United States Fire Administration, 1980, p. 56-57.

12."Mean Streets 2000", Barbara McCann and Brianca DeVille, Surface Transportation Project, 2000.

13. "Travel and Built Environment", Robert Cervero and Reid Ewing, (forth coming).

14. "Land Use and Transportation Interaction: Implications on Public Health and Quality of Life", Journal of Planning, Education, and Research, Oct. 2000.